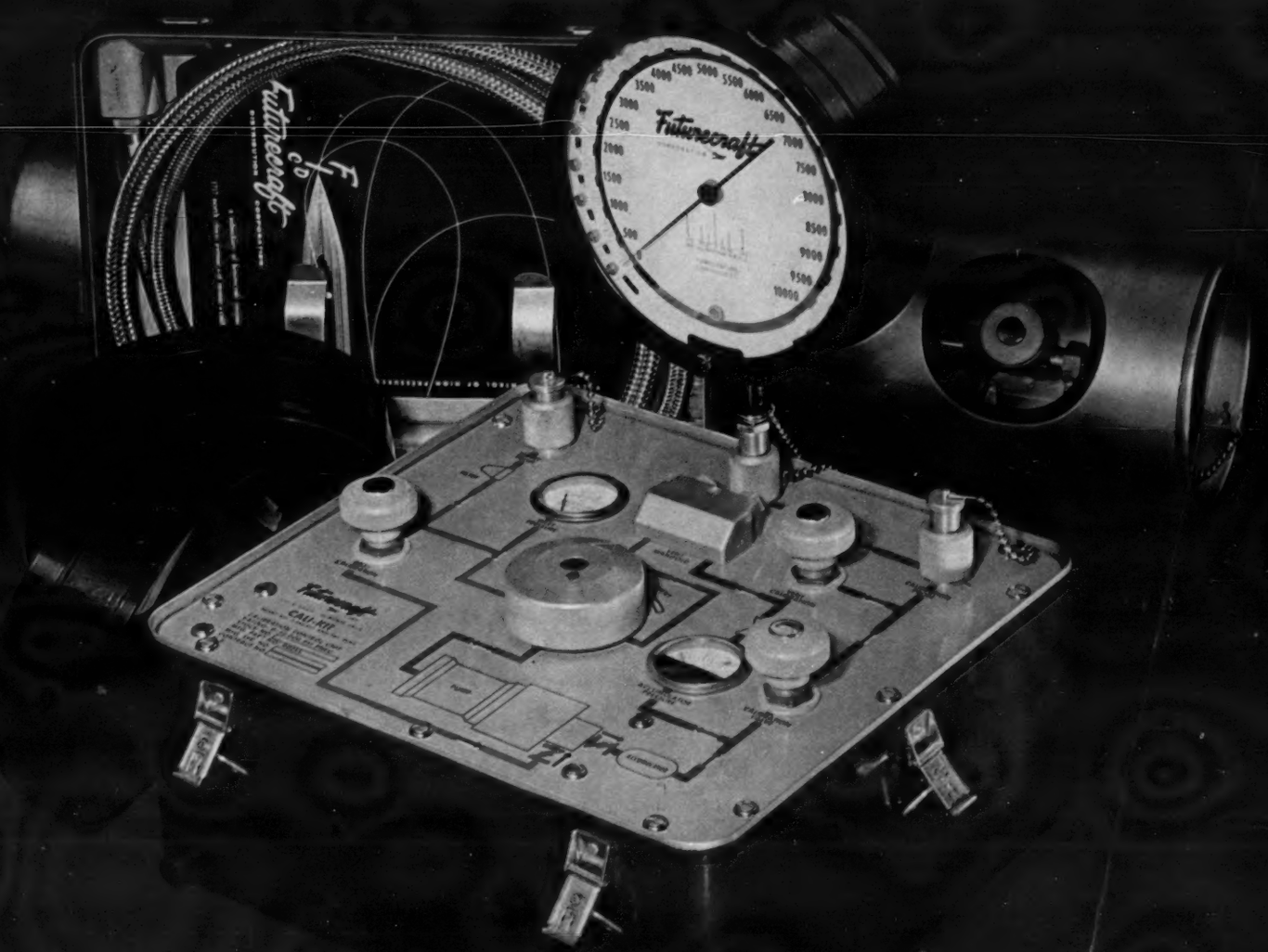
Design News

Portable gage calibrator. Page 4



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OCTOBER 13, 1961

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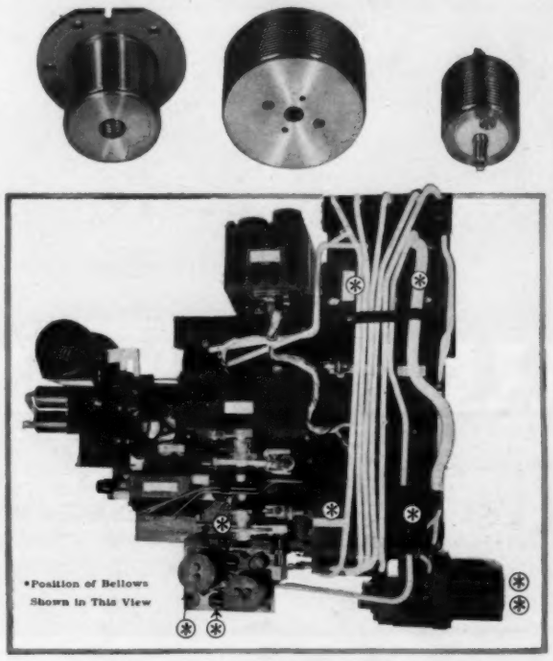

As Seen In a B-70 air inlet control by Hamilton Standard

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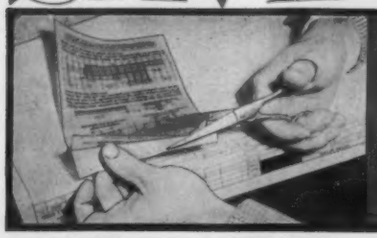

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SOUNDING BOARD

FOR OUR READERS

S 1884

Enclosed is the statement of our office presented before the Subcommittee on Patents, Trademarks and Copyrights of the Senate Judiciary Committee, August 16, 1961. We feel you might be interested in it in that it reflects the view of the designer and also is closely related to our whole moral outlook of the present moment . . .

JACK WALDHEIM & EARL KOEPKE
Waldheim-Koepke Associates
1806 N. Farwell Ave.
Milwaukee 2, Wis.

• **See DESIGN VIEWS on opposite page.**

A Misunderstanding

In reply to your letter concerning the booklet, "The First Man in Space", which was listed in the free literature column of DESIGN NEWS: my firm did not send any copy of this publication to your journal and we cannot take responsibility for the fact that a notice about the booklet appeared in your free publications column. The price of "The First Man in Space" is $0.50 and this is indicated clearly in all our promotion material.

Apparently the copy you received was sent by the Press Department of the Soviet Embassy which purchased a quantity of the booklet from us for free distribution.

We are willing to notify all of your readers who inquired about the booklet as to cost and availability. More than this we cannot do.

I regret the misunderstanding.

MYRON E. SHARPE
Publisher
Crosscurrents Press, Inc.
156 Fifth Ave.
New York 10, N. Y.

• **We regret any inconvenience the above misunderstanding may have caused our readers. We do not knowingly run any material in our New Literature column for which there is a charge.**

Fourth Dimension in Design

Your article entitled "Fourth Dimension" in the August issue of DESIGN NEWS was most interesting.

May I add, Mr. Estes' talk was very well presented to our Industrial Designers Institute group, at our 1961 National Award Meeting, in Chicago last June.

Indeed, the future of America's technological race depends on the scientific, as well as the creative, effort of all engineers and designers. Our free exchange of ideas is vital, and so well expressed in DESIGN NEWS . . . The challenge is ours.

GEORGE R. ROOS, SECRETARY
Chicago Chapter
Industrial Designers Institute
5690 W. Goodman St.
Chicago 30, Ill.

Cycloidal-Cam Speed Reducer

I understand that in your August 18 issue you published an article on a cycloid reduction gear.

As I was the first one to publish an article on this subject in the United States, I would appreciate receiving a copy of that issue. If you so desire, I shall be glad to let you have my comments on that article, after studying it.

D. W. BOTSTIBER
Consulting Engineer
307 South Chester Pike
Glenolden, Pa.

• **Copy of August 18 issue sent.**

Decline and Fall

Re: "Sounding Board" letter by Paul P. Leo in the Sept. 1 issue:

Mr. Leo hopes that the answer (to the last question in your "Decline and Fall") will continue to be a "resounding 'no' ". Now if enough other technical people think, as Mr. Leo thinks, that it sounds "stuffy" to say "pray", then I am extremely doubtful about the continued resonance of the "no" he speaks of.

B. L. MATHIS
1356 Wilmerding Ave.
East McKeesport, Pa.

So Johnny Can't Write

Because of the vacation season, I have just had the opportunity to read the editorial in your July 7 issue—this is the one entitled "So Johnny Can't Write . . . "

The thoughts expressed in this editorial are certainly pertinent and emphasize the difficulty which people have who have not learned to express themselves well, either by the written or spoken word.

The thoughts in the final paragraph of your editorial certainly hit straight at the heart of the problem. However, since I am an old PTA'er, I would just like to voice the thought that the PTA's who are having children sell tickets have certainly missed the main point of PTA. The Parent-Teacher Association, as I understand it, is primarily intended to get parents and teachers to work together in order to better educate the children.

Any PTA which does not do this fundamental thing is, it seems to me, wasting the time of its members. That child is indeed fortunate whose parents are working with the teachers in helping him become educated. All too many parents are working against the teacher.

A. H. MILLER
Durametallic Corp.
2104 Factory St.
Kalamazoo, Mich.

S 1884

The letter from Jack Waldheim (opposite page) included the text of his testimony before the Senate Subcommittee on Patents, Trademarks and Copyrights in support of a bill known as S 1884.

One paragraph of this testimony was particularly intriguing: "Our society is based upon rules of conduct, these in turn are based upon protection of the majority. Truly the question before us is—Is the majority being protected by the permission of wholesale pirating of design as now practiced? I think not."

This seemed worth following up. After first obtaining a copy of the bill from my senator, I checked with the Department of Commerce in Washington on a number of aspects of this bill. S 1884, the Design Protection Act of 1961, is still in the Senate Judiciary Committee. As stated in the bill, it is intended "to encourage the creation of original ornamental designs of useful articles by protecting the authors of such designs for a limited time against unauthorized copy". Briefly, it provides for 5- or 10-year protection of industrial designs which are properly registered and which show this fact in a label or other marking. The bill also provides for penalties against willful infringement and it definitely states that an article to be protected under the act must have an intrinsic utilitarian function. Conversely, it eliminates from protection designs lacking originality and designs made up of standard figures of familiar symbols.

According to spokesmen in Washington, the new legislation is warranted and desirable. I find an unusual amount of cooperation between the segments of the design field lobbying for the bill and the Patent Office, for instance.

The Design Protection Act of 1961 deserves your support. The bill is intended to protect those designs on useful articles which could not otherwise be protected either under the present design patent or copyright laws. A note to your senator, I am sure, will bring you a copy by return mail should you be interested in the details.

J. C. Dubois

Executive Editor

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Separating Diaphragm Permits In-System Calibration of Pressure Gages

Edward W. Schrader, Western Editor

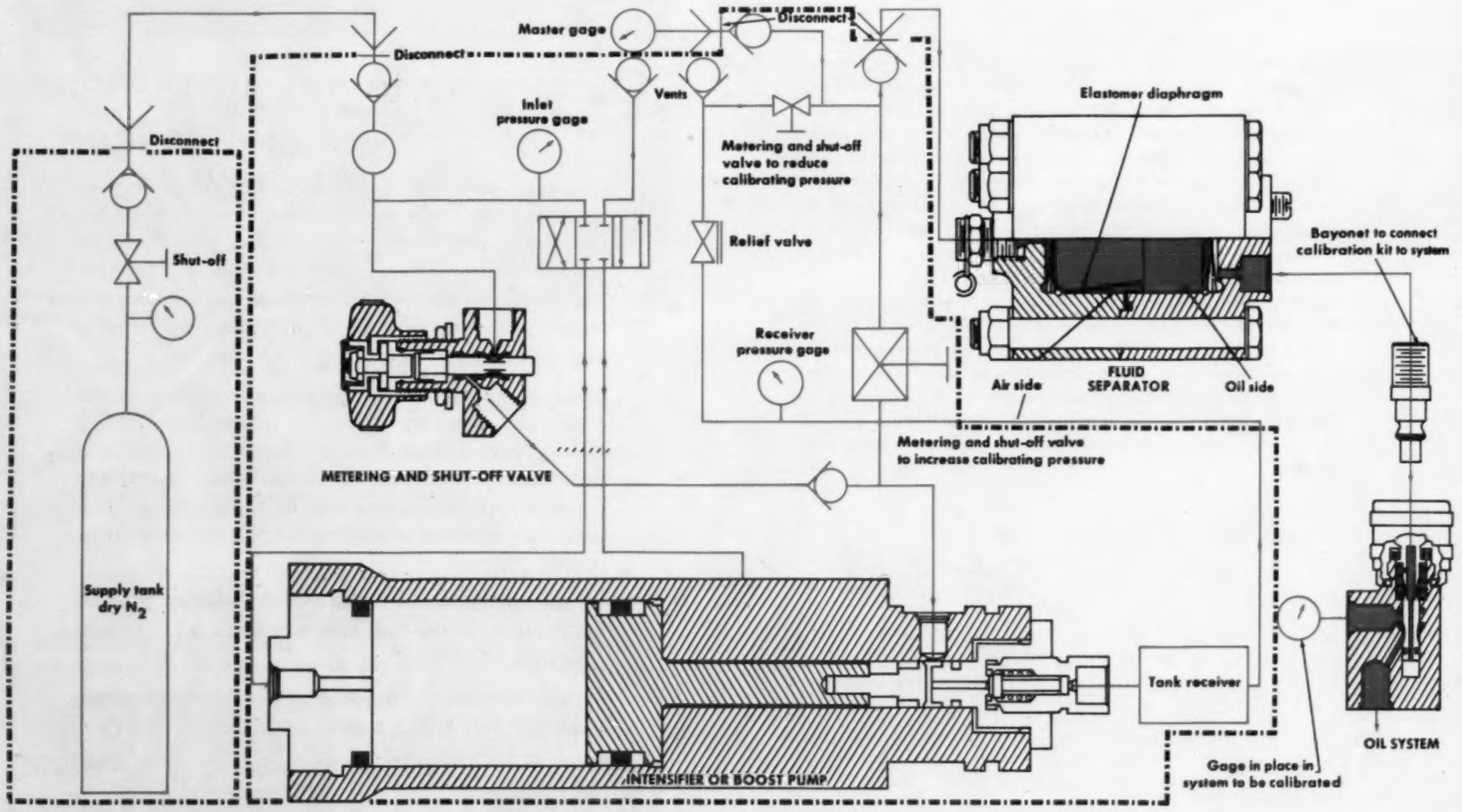
An elastomer diaphragm separates the liquid system from the clean, dry pneumatic pressure for in-system calibration of gages. The portable calibration kit simplifies the periodic calibration of pressure-sensing components.

The fluid separator isolates the system fluid, and it transmits pressure without introducing any measurable error in the calibration. The separator also connects a dead weight tester to the device when verifying the accuracy of the master gages in the kit.

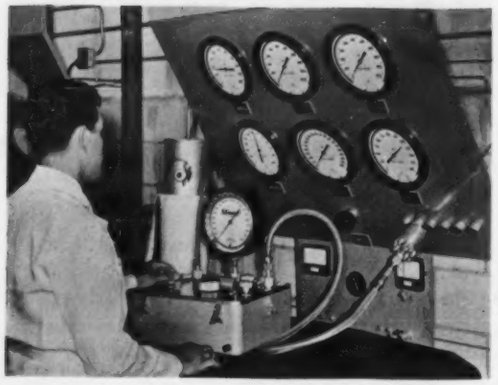
A bayonet, or plug-in disconnect, joins the fluid separator pressure line to the gage to be calibrated. In the normal position, system fluid pressure reaches the gage through grooves on the spool of the disconnect poppet. When the bayonet is inserted to calibrate the gage, the spool connects the gage to the fluid separator pressure line.

To perform an in-system calibration of a gage, a combination metering and shut-off valve supplies dry nitrogen simultaneously to a master gage and to the pneumatic side of the fluid separator, or directly into a pneumatic system gage. No regulators are used.

By metering pneumatic pressure for the desired



DRY NITROGEN from supply tank enters controller through disconnect and filter. Metering and shut-off valve supplies pressure directly to receiver tank for calibrating at lower pressures. Two additional metering and shut-off valves increase or decrease pneumatic pressure to master gage and air side of fluid separator. Elastomer diaphragm isolates system fluid from nitrogen and transmits pressure to bayonet disconnect and then to gage to be calibrated in system. Four-way, three-position manually operated valve operates boost pump to increase receiver pressure above pressure supplied by nitrogen bottle. Poppets in check valves close on metal seats. Back pressure of system operates on outside of O-ring.



IN-SYSTEM CALIBRATION OF PRESSURE GAGES saves time and prevents system contamination. Probe disconnects eliminate change of damage to fittings or system leaks caused by removing gages for calibration. When probe is inserted, gage is automatically isolated from system and connected to calibration line.

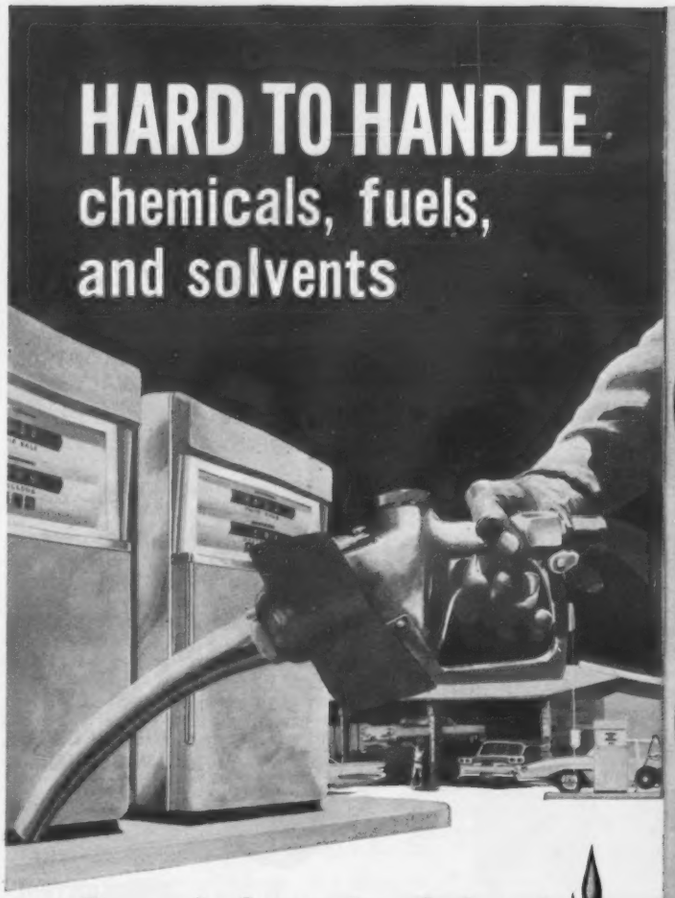
reading points over the range of the gage, and by shutting off the supply at each point read, direct calibration is made. To decrease calibration pressures, a second metering and shut-off valve bleeds the pressure to the atmosphere so that decreasing as well as increasing readings may be taken.

The pressure controller gives accurate supply pressure for a calibration range from 1 mm of water (0.0014 psi) to 10,000 psi. The bottled nitrogen source will normally supply 400 psi to 3000 psi. A boost pump or intensifier boosts the inlet pressure by a factor of 10 to 1 to reach the maximum calibrating pressure.

Component parts are either patented or under patent application. The Cali-Kit for in-system calibration of pressure gages is a design development of Futurecraft Corp., El Monte, Calif.

DEAD WEIGHT TESTER is primary standard for calibrating master gages used in portable calibration kit. Fluid separator joins kit and dead weight tester. Master gages are accurate to 0.001 percent of full scale.

HARD TO HANDLE chemicals, fuels, and solvents



Special materials to tame tough fluids

Handling volatile and chemically reactive liquids is a critical problem requiring very selective use of materials in the manufacture of component parts which control, meter, pump or contain these liquids. Tough corrosive problems, as well as great extremes of temperature must often be overcome.

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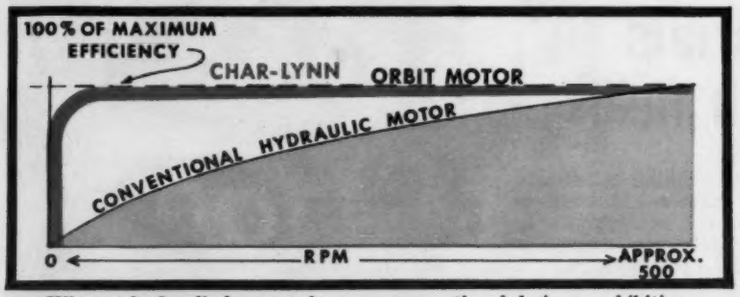

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- Starting torque substantially equal to running torque
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complete your HYDRAULIC CIRCUITS with Char-Lynn COMPONENTS

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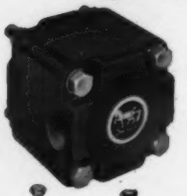

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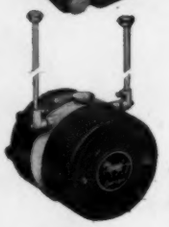

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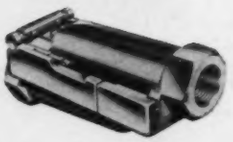
HORSEPOWER CYLINDER C-102

HYDRAULIC FLUID FILTER F-240



HOSE COUPLER H-730

For complete details write Dept. HM Char-Lynn Company • 2843-26th Avenue South, Minneapolis, Minnesota

Char-Lynn HYDRAULIC HORSEPOWER PRODUCTS

Concentrically Nested Load Members

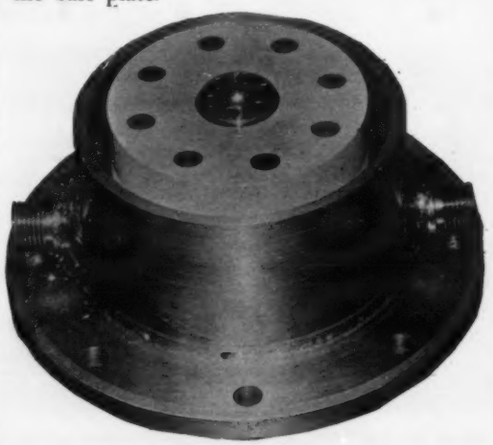
Ronald W. E. Martin, British Editor

In a new load cell, load is transmitted through two concentric tubes, the inner tube of which is in tension and the outer in compression. Sensitivity is greater than standard pillar-type cells since the tubular members are equally loaded in compression and tension, and the strains of both are indicated. An additional feature is a higher diameter-to-height ratio, making the cell more tolerable of side thrust.

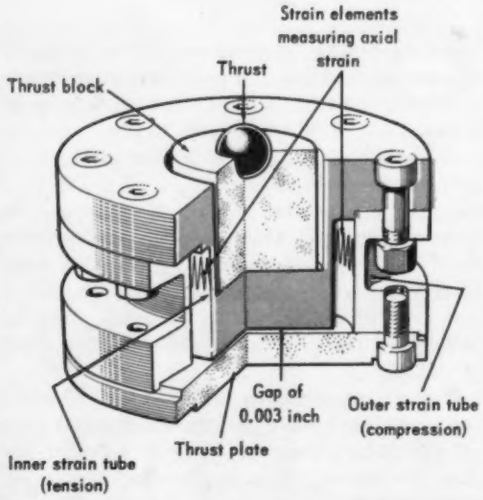
The cell consists basically of the two tubular members (high-tensile steel, aluminum alloy or beryllium copper); the force to be measured is applied through a ball and block to an internal face of the inner tube. The open end of this tube has a rim which bears on the face of the outer tube, the lower face of which is spigoted on the thrust plate. The inner member, therefore, is subjected to tensile stress and the outer to compressive stress.

Strain elements are attached side-by-side on the inner tube to cover its circumference. The same number of elements is attached to the outer tube. This insures that cell output is proportional to the integrated strain in the tubes. As a result, off-center loads will not affect the total strain recorded.

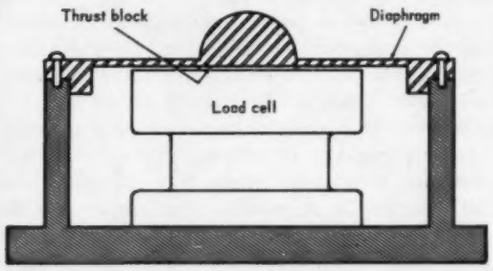
Protection against overload is provided by a small clearance (0.003 inch) between the lower end of the inner tube and the base of the cell. This clearance closes up on overload so that thrust is transmitted directly from the tube to the base plate.



Increase Sensitivity of Load Cell



DIAMETER-TO-HEIGHT RATIO of cell is decreased substantially by using two concentrically nested tubes instead of solid pillar. For given cross-sectional area, arrangement allows increase in diameter and reduction in length while providing increased surface area for attachment of strain gages.



MODIFIED CELL embodies diaphragm permitting it to withstand inclined loads of up to 11-1/2 deg. Outer face of cell housing supports outer rim of diaphragm, center of which bears on thrust block.

Developed by D. S. Dean, Rocket Propulsion Establishment, Ministry of Aviation, Wescott, England, the cell is capable of sustaining side loads of up to five percent of designed axial load without damage. It gives outputs reproducible to better than ±0.1 percent of full-scale output on rising or falling loads. Cells are constructed in different sizes with capacities ranging from 1/2 ton to 100 tons.

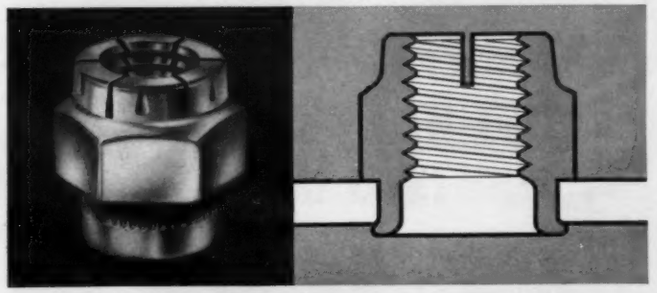
3 quick ways to put load-bearing threads in thin material... permanently!

These SPS 160,000 psi clinch and swage nuts are designed expressly to provide one-piece, all-metal thread wells in thin-section materials of .020 inches and more. Installed with one pressure stroke, they become a permanent, vibration-proof part of your product. No more loose nuts to handle; no need to hold nuts with a wrench while tightening screws. Result: faster, more economical assembly, particularly where it would be awkward to position and hold ordinary nuts. And these same benefits apply to later disassembly and reassembly in the field.

FLEXLOC Self-Locking Clinch Nuts

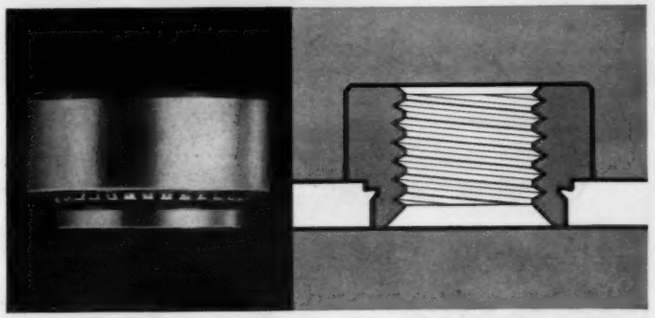
Designed for thin-section materials up to Rockwell C20 hardness. Incorporating the time-proven FLEXLOC self-locking feature, they are specially valuable where equipment must be disassembled periodically. Installed by roll-over clinch method with SPS punch and dolly tips.* Sizes #4 through 5/16 inch in cadmium-plated steel (serviceable to 550°F), stainless steel (to 800°F), brass and aluminum (to 250°F). Also microsizes—#0 to #4—in same materials. Locking torque and vibration requirements meet or exceed MIL-N-25027.

*Recommended installation tools available as standard products. Dolly tips for flush mounted clinch nuts also available.



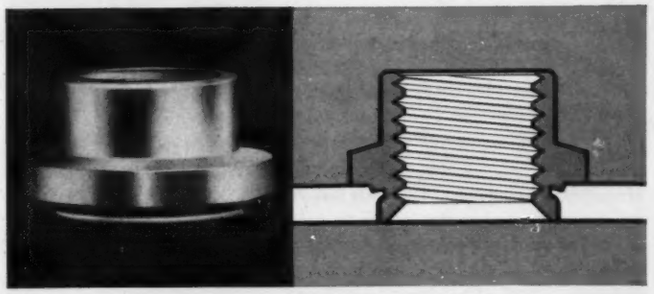
SPS Swage Nuts

The simple, economical solution to the problem of getting sufficient load-bearing threads in thin material. Installed from one side, they mount flush—without use of special tools and without distortion or discoloration of parts. Suitable for materials to Rockwell C25 (this includes mild steels). Good torque-out and push-out values assured by positive displacement of metal into retaining groove. Sizes #2 through ½ inch in cadmium-plated steel. Serviceable to 550°F.



SPS Self-Locking Swage Nuts

Provide flush mounted, self-locking thread element which combines excellent performance with light weight. Installed from one side—with SPS dolly tip—in materials up to Rockwell C27. Push-out and torque-out values, as well as locking torque and vibration requirements, meet or exceed MIL-N-25027. Sizes #2 through ½ inch in cadmium-plated steel. Serviceable to 550°F.



SPS

where reliability replaces probability

SPS alone offers you this range of one-piece nuts designed specifically for fastening in thin-section materials. And SPS offers them from stock—available for fast delivery through your SPS distributor. Individual bulletins are available on each of these special-purpose SPS nuts—Bulletins #2275 (clinch nuts), #2447 (swage nuts), #2701 (self-locking swage nuts). For copies, write Standard Pressed Steel Co., INDUSTRIAL FASTENER DIVISION, SPS, JENKINTOWN 6, PENNSYLVANIA.

Circle 6 on Reader-Service Card for more information

Valve Parts Flex to

E. J. Stefanides, Central States Editor

Eight double-disc, parallel-seat valves, actuated by separate dual-function pneumatic systems, are used to control the high-pressure air supply in a supersonic wind-tunnel test facility.

Huge quantities of air at 500 psi are reduced through a control valve to 20 or 30 psi. During the reduction process, the air is accelerated to supersonic speeds. The shut-off valves prevent the downstream piping and test chamber from being subjected to abnormally high pressures in the event of control failure or other malfunction. They also provide normal shut-off control of the air.

Primary consideration in design of the system was providing a valve package which could shut off the 20-inch nominal diameter valve in less than one second. This meant accelerating the several-hundred-pound mass of the gate action valve while subjected to 500-psi pressure to a rate of closure of 24 ips. Deceleration of the valve is accomplished by the seating action.

Requirements not only subject the valve to stringent impact conditions, but also introduce the possibility of the valve being jammed in its seat during closing.

A double-disc, parallel-seat valve was chosen as the component to best meet these requirements. The valve is designed so that the valve structure flexes under closing forces.

The valve is actuated by a double-acting, long-stroke pneumatic cylinder controlled by a dual-function pneumatic system. The system consists of two circuits in parallel. One circuit consists of a pilot-operated, solenoid-controlled, four-way valve which supplies air at 500-psi pressure at a restricted rate to provide opening and closing at normal service rates. During emergency shut-off, a separate solenoid actuates two differential piston pilot valves. One of these valves supplies 500-psi high-pressure air to the top of the cylinder through large-diameter piping; the other vents to the bottom of the cylinder. This is supplemented by the normal action of the four-way valve. The combination of these parallel supply and venting actions results in a rate of closure which allows the valve to close in 0.53 sec.

The valve and its actuating system were designed and are manufactured by the Darling Valve and Mfg. Co., Williamsport, Pa.

"We wanted nickel-chromium ingots rolled to foil .0005" ± .00005" thick with a width of .188" ± .001" x coil, with a breaking load of 7 to 9 lbs., and a blemish-free mirror finish. Hamilton did it for us."

says T. J. Scanlon, Purchasing Agent, Electron Tube Division Radio Corporation of America, Harrison, New Jersey

PRECISION IS OUR PROVINCE. Working to minimum thickness of .00008", mimimum widths of ½", Hamilton can supply you with foil or strip . . . rod or wire . . . of virtually any alloy in production quantities. Our full-scale, completely-integrated facilities and engineering talent in this field permit absolute quality control from melt to finish. Thanks to these capabilities . . . a familiarity with precision work inherited from Hamilton's watchmaking background . . . experience with ultra-thin foils unmatched anywhere in the world . . . we offer you precision metals to meet your exact property and delivery requirements. We guarantee our product. Call us.

For additional information on Hamilton's facilities and capabilities, send for free booklet, "Precision Metallurgical Services." Write Dept. 3610, Metals and Electronics Div., Hamilton Watch Co., Lancaster, Penna.

HAMILTON WATCH COMPANY

Metals and Electronics Division, Lancaster, Penna.

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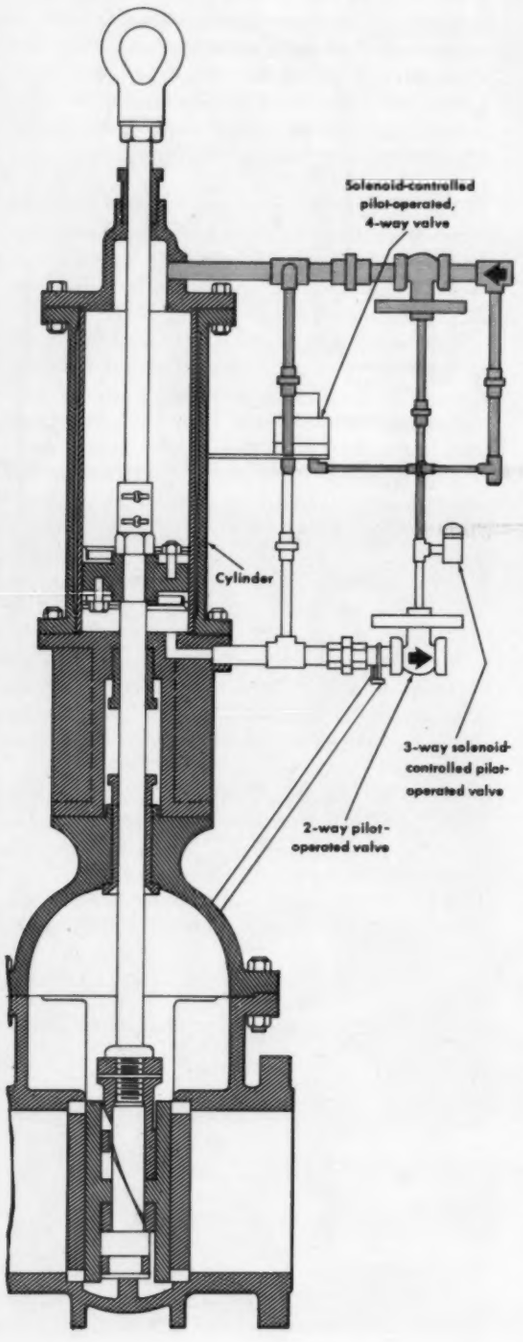
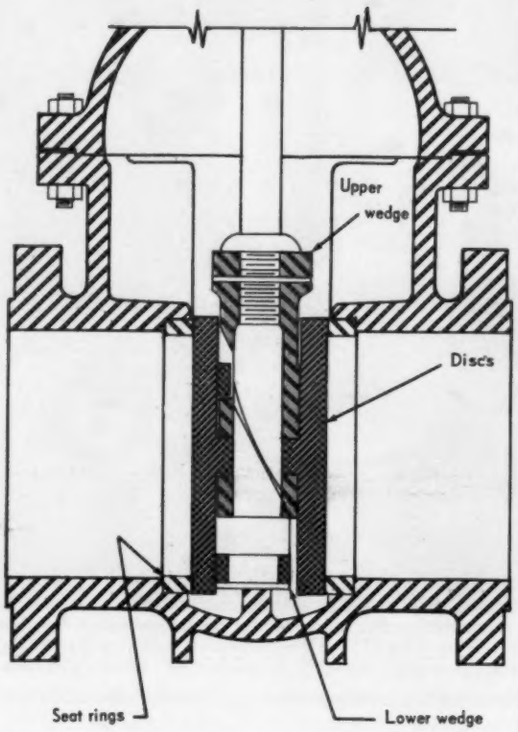
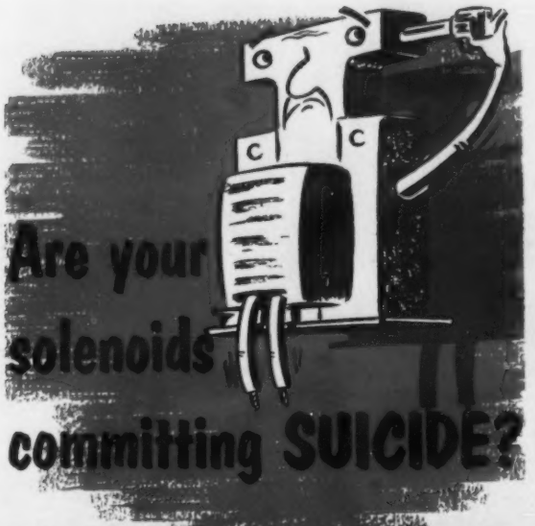
Absorb Impact Energy of Emergency Shut-Off



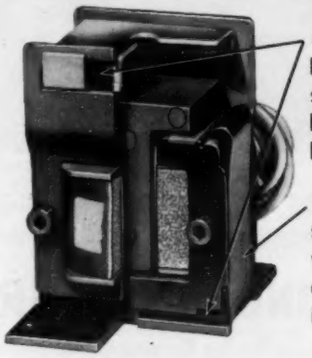


VALVE consists of two discs supported on trunnions which fit loosely into upper wedge. Discs are seated by cam action of upper and lower wedges. In final phase of closing, lower wedge bottoms on bridge and further movement drives discs outward against seats, deflecting them slightly. Parts now act as very stiff springs, absorbing and storing part of impact energy of closing. Stored energy is released later during initial phase of opening, preventing jamming of valve in closed position.

SECTION through valve and control circuit layout shows how normal service and emergency shut-off circuits are paralleled. This arrangement provides restricted flow for normal operation and maximum capacity during emergency shut-off. Both circuits are controlled by solenoids which are de-energized to provide closing actions. Arrangement provides automatic emergency shut-off in case of power failure. Both circuits are pilot-operated from low-pressure (100 psi) air. In emergency, shut-off solenoid vents control side (large area) of differential piston supplying high-pressure (500 psi) air to top of piston and rapidly venting bottom side. Miniature limit switches control indicator lights.



Decco TWO-WAY SHOCK-MOUNTING CAN TRIPLE SOLENOID LIFE!



- Shock absorbing bumpers cushion stroke, assure longer service life.
- Tempered steel spring absorbs vibration— holds assembly firmly in alignment.

The greatest cause of solenoid "deaths" is the relentless impact of unspent stroke-force on the solenoid's structure.

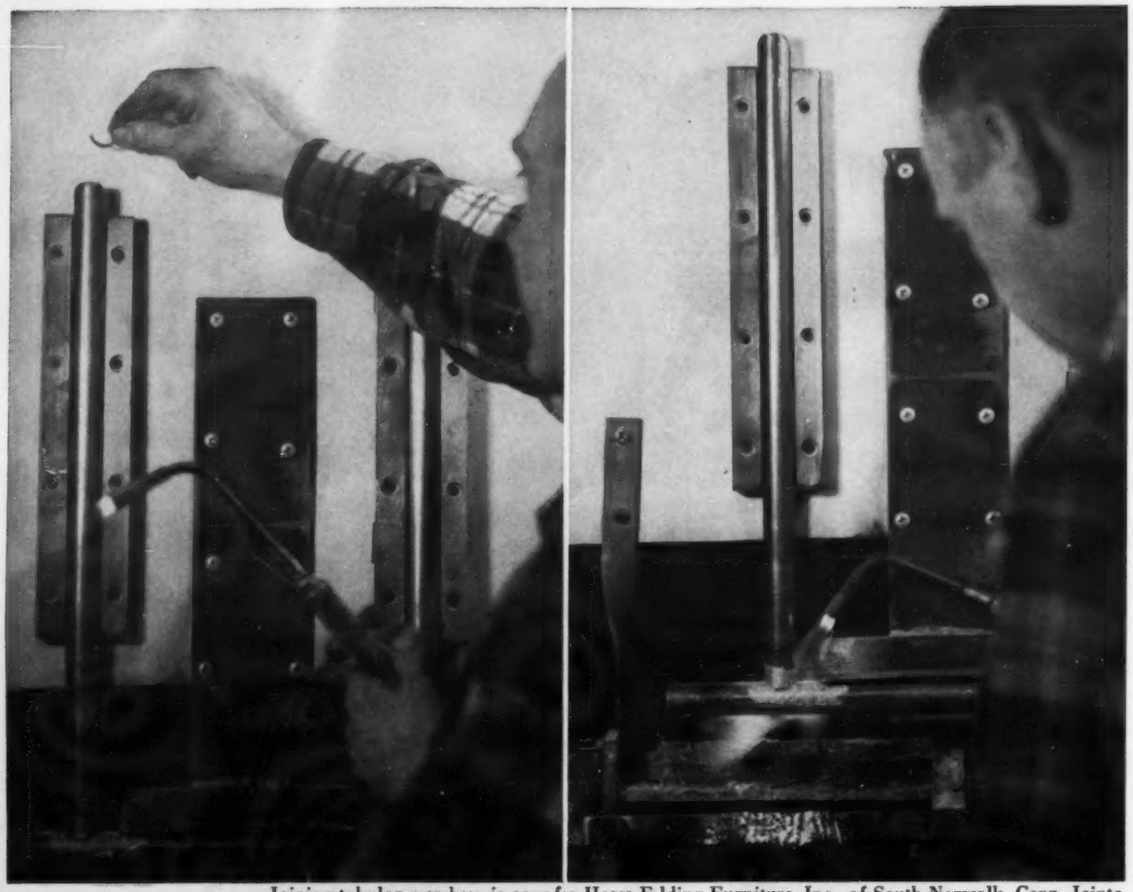
Rugged DECCO INDUSTRIAL SOLENOIDS refuse to take this terrific self-punishment. They "fight back" with built-in, two-way shock absorbing bumpers which add millions of strokes to the life of the solenoid.

Precision-built from the best quality materials, DECCO's complete line of industrial solenoids provide that extra-engineered stamina so necessary to keep solenoid replacement to a minimum.

Decco engineers will gladly discuss your solenoid problems.

DETROIT COIL COMPANY
2435 Hilton Road • Ferndale 20, Mich.

Circle 8 on Reader-Service Card for more information



Joining tubular members is easy for Howe Folding Furniture, Inc., of South Norwalk, Conn. Joints are fluxed with Handy Flux, a half-circle preform of EASY-FLO brazing alloy is dropped down the tube and a torch is applied. Result: A smooth, strong joint quickly and economically made.

How Handy & Harman Brazing Alloys

GIVE FOLDING FURNITURE 100% JOINT RELIABILITY

The experience of Howe Folding Furniture, Inc., with silver brazing merits close attention if your operations involve metal-to-metal joining of any kind. Howe manufactures folding metal tables and seats for commercial, industrial and institutional use. You can imagine the hard usage the furniture has to take—yet survive indefinitely.

Some years ago, it was Howe's practice to purchase prefabricated steel tubular assemblies in which the joints were brass brazed on the outside surface. To improve their product, Howe thoroughly tested all joining methods, and decided to go over to silver brazing in their own plant, using Handy & Harman EASY-FLO Alloys 45 and 35. Look at the results:

Complete Joint Reliability: Since adopting silver brazing, Howe has completely eliminated the problem of broken joints.

Economy: Silver brazing costs Howe less than other methods, requires less heating time, simpler equipment, much less cleaning and grinding of joints.

Appearance: Silver brazing provides a smoother, more attractive joint, that can be plated directly.

Is it any wonder Howe says: "We'd stay with silver brazing even if it cost more." There are few fields of industrial activity where the strength, high production rates and economy afforded by the Handy & Harman family of silver brazing alloys cannot improve the look of the balance sheet. Interested in complete details? Just write for a copy of our Bulletin 20 — it's packed with engineering and application data.

Howe cafeteria table-bench is converted to an auditorium bench with backrest in a single motion. Silver brazed joints easily absorb strains.

HANDY & HARMAN
850 Third Avenue, New York 22, N.Y.
PLaza 2-3400

Circle 9 on Reader-Service Card for more information

Centrifugal Action Increases

R. F. Stengel, German Editor

A novel device uses a set of steam-heated conical elements for high-speed evaporation. Liquid is sprayed on the heated surfaces of the rotor elements and is spread by centrifugal force into a thin but turbulent film. Conditions for heat transfer are optimal, while rapid evaporation protects heat-sensitive liquids from thermal decomposition.

The conical elements are hollow; thickness tapers from the periphery toward the center and both upper and lower surfaces are inclined outward. Walls are made of stainless steel. The set of six elements rests on a hollow shaft.

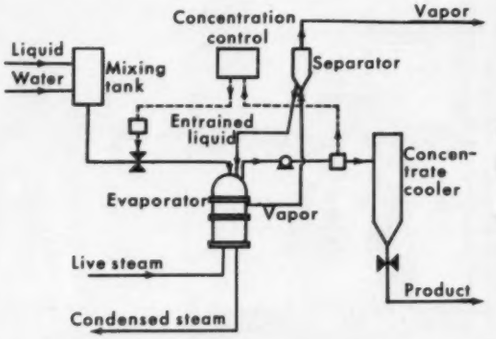
Heat is supplied by steam entering from below through the rotor shaft into the conical elements. Centrifugal force flings condensed water through radial bores toward rotor walls where it collects and leaves through a pipe in the motor shaft.

The liquid to be evaporated enters from the top in a vertical feed pipe closed at the bottom. A set of nozzles sprays the liquid upward against the lower surfaces of the conical elements. Centrifugal force, reaching 200G, spreads the liquid immediately into a layer which is only about 0.004 inch thick.

Time spent on the evaporator surface is extremely short: 1 to 2 sec depending on liquid viscosity. High flow rate keeps the liquid in the turbulent range, which adds to effective heat transfer.

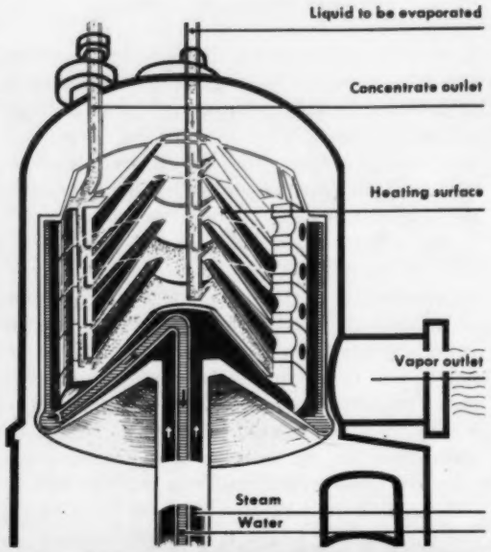
The concentrate is forced against the inside wall of the rotor and rises through a stripper pipe. Vapors leaving the heated surfaces are withdrawn separately under vacuum.

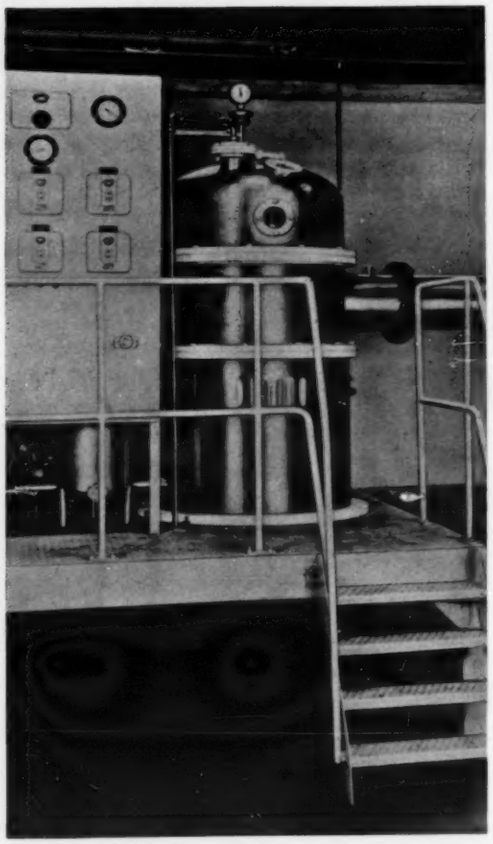
The "Centri-Therm" evaporator is a development of AB Separator, Stockholm, Sweden.



SIMPLIFIED FLOWSHEET of evaporator installation.

Effectiveness of Film Evaporator





Whatever you make... there's a WALDES TRUARC® RETAINING RING designed to improve your product...lower assembly costs

function		for axial assembly					for taking up end-play: axial assembly				for taking up end-play: radial assembly	
nomenclature		basic		heavy duty	inverted		bowed		beveled		bowed e-ring	prong-lock™
series no.		5000 N5000	5100	5160	5008	5108	N5001	5101	5002 N5002	5102	5131	5139
application		Internal for Housings, Bores	External for Shafts	External for Shafts	Internal for Housings, Bores	External for Shafts	Internal for Housings, Bores	External for Shafts	Internal for Housings, Bores	External for Shafts	External for Shafts	External for Shafts
size range	in.	.250 – 10.0	.125 – 10.0	.394 – 2.0	.750 – 4.0	.500 – 4.0	.250 – 1.500	.188 – 1.500	1.0 – 10.0	1.0 – 10.0	.110 – 1.375	.092 – .438
	mm.	6.4 – 254.0	3.2 – 254.0	10.0 – 50.8	19.0 – 101.6	12.7 – 101.6	6.4 – 38.1	4.8 – 38.1	25.4 – 254.0	25.4 – 254.0	2.8 – 34.9	•

function		for radial assembly				self-locking types					
nomenclature		crescent™	e-ring	interlocking	reinforced e-ring	circular self-locking			grip-ring	triangular self-locking	triangular nut
series no.		5103	5133	5107	5144	5115	5105	5005	5555	5305	5300
application		External for Shafts	External for Shafts	External for Shafts	External for Shafts	External for Shafts	External for Shafts	Internal for Housings, Bores	External for Shafts	External for Shafts	With Threaded Screw
size range	in.	.125 – 2.0	.040 – 1.375	.469 – 3.375	.094 – .562	.094 – 1.0	.094 – 1.0	.312 – 2.0	.079 – .750	.062 – .438	•
	mm.	3.2 – 50.8	1.0 – 34.9	11.9 – 85.7	2.4 – 14.3	•	•	•	2.0 – 19.0	•	•

Truarc retaining rings are precision-engineered fasteners which simplify design, speed production and reduce material, machining and assembly costs. They may be used to retain components on shafts and in bores and housings .040" to 10" dia. – and rings as large as 40" dia. have been developed for special applications! Truarc rings are installed in easy-to-cut grooves and self-locking types are available which do not require any preparatory machining. Altogether, there are 50 functionally different types . . . some with as many as 98 sizes . . . in 6 metals and 13 finishes.

More than a fastener! Truarc rings function as mechanical components by replacing machined shoulders, set collars, rivets, threaded fasteners and other bulkier and more expensive fastening devices. They eliminate drilling, tapping, threading and other costly machining operations. Speed of assembly and disassembly further reduces manufacturing costs and simplifies field service.

Assembly tools for every requirement: Truarc offers you the most complete line of pliers, applicators, dispensers and portable magazine-fed tools for high-speed ring installation . . . even fully mechanized and automated equipment for mass-production assembly operations.

Engineering Service: We'll be happy to help you solve *your* fastening problems. Send us your blueprints or contact your local Truarc representative or distributor. They're listed in the Classified Telephone Directory under "Retaining Rings" or "Rings, Retaining."

WALDES KOHINOOR, INC.
47-16 Austel Place • Long Island City 1, N.Y.

WALDES TRUARC® RETAINING RINGS

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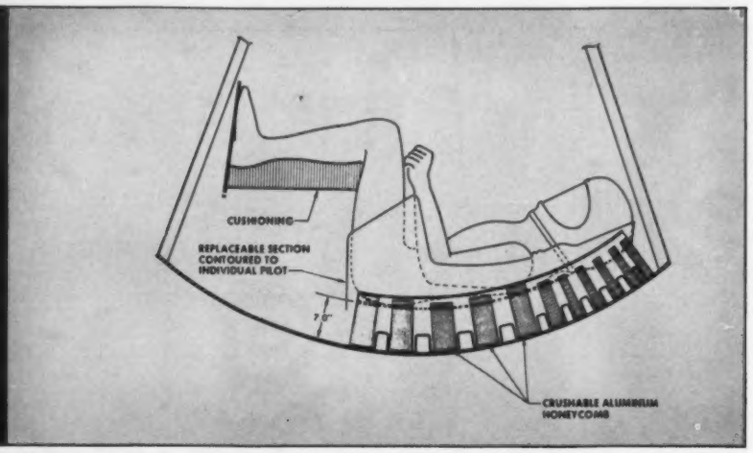
HEXCEL HONEYCOMB ABSORBS 9G's FOR ASTRONAUT



When Freedom VII opened its parachutes after re-entry, Hexcel crushable aluminum honeycomb absorbed 9 g's deceleration force, to help bring the first U. S. astronaut safely back to earth.

Use of crushable honeycomb for control of forces on decelerating objects is now being applied to such varied tasks as packaging fragile items, providing impact-limiting linkages in landing gear structures and cushioning the impact of air-dropped supplies.

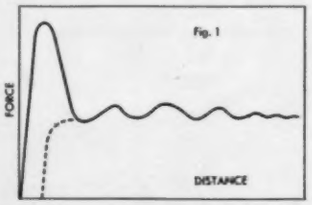
The Problem

Instances requiring impact energy absorption are generally typified by low tolerable deceleration rates for the structure or its contents, high impact velocities, and small maximum allowable stopping distances. Such absorbers as mechanical springs, sponge or solid rubber, foams, cork, and wadding generally exhibit spring characteristics, in that the force transmitted through these absorbers to the object being stopped increases continuously through the distance in which the absorbers contract. In addition, many of these materials do not absorb energy, but merely store it for release as rebound energy.

If an absorber could exert a relatively constant non-rebound force throughout the entire stopping distance, that distance could be shortened, or alternately, the maximum force acting on the object in the same stopping distance could be materially reduced.

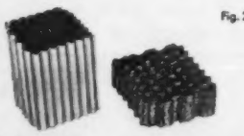
Advantages of Honeycomb

Honeycomb core materials tend to follow such a constant force curve, as shown in Figure 1.



The initial peak on the curve represents the point at which compressive failure begins. This peak can be lowered by prestressing the core to produce slight initial compressive failure. When subjected to further or subsequent loading, the prestressed core proceeds immediately to carry the crushing load, as shown by the dashed line curve in Figure 1.

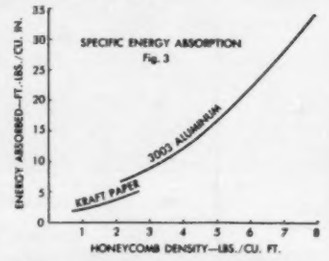
Figure 2 illustrates the appearance of aluminum honeycomb core before and after compressive failure.



By designing a honeycomb core assembly with a specified cell depth this constant force can be applied over a predetermined stopping distance.

Available Materials

These principles apply to aluminum and paper honeycomb, and most similar honeycomb core materials fabricated from ductile metals and fabrics. Figure 3 indicates the general range of energy absorption capacity available in aluminum and paper materials.



These capacities can be further increased by filling the cells with various foamed materials.

Optimum Solution

The choice of materials by the designer will depend upon the particular requirements of the application. But it seems apparent that the utilization of honeycomb offers the optimum solution—in terms of weight and volumetric efficiency—to many types of energy absorption problems.

If you would like further information on the uses of honeycomb for energy absorption or other applications, consult *Sweet's Product Design* catalog or complete the information request at left.

INFORMATION REQUEST

Send to Hexcel Products Inc., Dept. D-10
2332 Fourth Street, Berkeley 10, California.

NAME_____
TITLE_____
COMPANY_____
STREET_____
CITY_____ ZONE___ STATE_____

HEXCEL® PRODUCTS INC.
Stronger, lightweight materials for industry
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Plants: Berkeley, Oakland, El Segundo, Calif.; Havre de Grace, Md.
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Circle 11 on Reader-Service Card for more information

Pivoting 'Three-Point' Pad

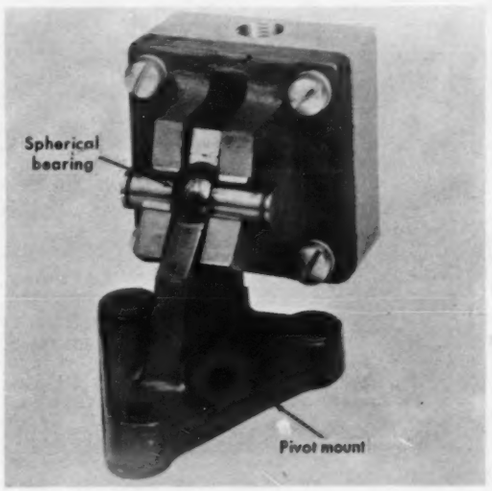
Victor W. Wigotsky, Eastern Editor

A three-point mounting surface, which pivots around a spherical bearing, simplifies assembly of pneumatic and hydraulic cylinders to their mating elements. The arrangement overcomes two basic problems—that of cylinder misalignment and the time-consuming and costly machining of mounting pads.

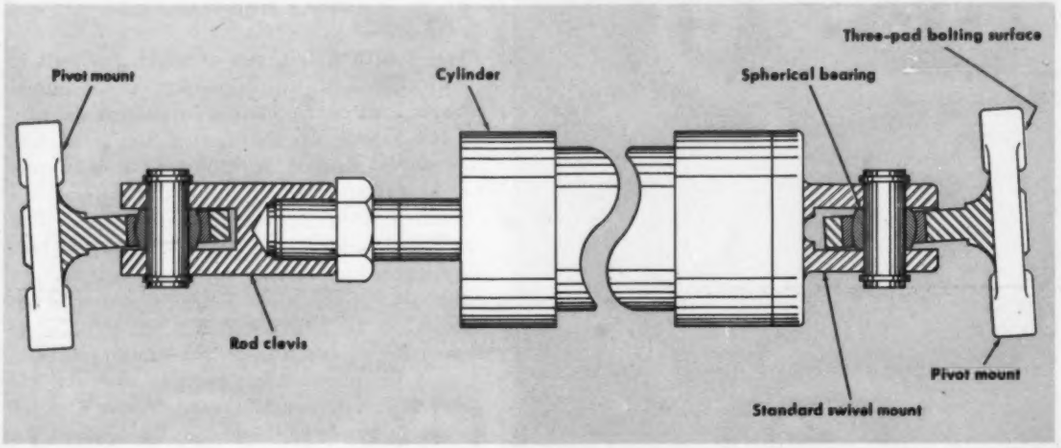
Misalignment of the assembled parts often results in reduced service life and excessive maintenance because of such factors as side loading and binding. The pivoting capability of the mount, provided by the spherical bearing, permits a plus or minus 3-1/2-deg self-alignment at each end of the cylinder. This also reduces assembly costs by minimizing critical fitting requirements on the cylinder and mating parts, such as a fixture, clamp, slide or machine tool.

Another important objective was to eliminate costly machining which is normally required to provide a mounting pad for the cylinder and one for the mating part. Use of a three-point surface on the pivot's mounting face overcomes the problem of surface irregularities. Three raised surfaces establish an independent mounting plane which permits use of "as-cast" surfaces. This eliminates additional mounting pads and reduces machining simply to the drilling of the mounting holes in the mating part.

The "Easy-Lign" cylinder mount was designed by Alkon Products Corp., Hawthorne, N.J.



Prevents Cylinder Misalignment



MOUNT is simple and economical to install. Spherical bearing is assembled into pivot mount. Latter then is mated with rod clevis and standard swivel mount. Seven-deg swing permits use of swivel and pivot method of cylinder mount in place of foot and flange mounts requiring machined mounting surfaces. Independent mounting plane, provided by three-pad mounting surface on each pivot's rear face, minimizes effect of surface irregularities.

Engineers and operators rely on these easily applied, streamlined Anchor Clamp-Type Couplings for fast, emergency repair and field service, as well as original equipment application.

Designed to accommodate normal variations in hose, they can be applied in the field with no tools other than a pair of automotive-type wrenches, and once applied, provide a sure, safe, leakproof connection that will remain intact up to the burst point of 2 and 3-wire braid hose.

Anchor Clamp-Type Reusable Couplings are supplied in high, medium or low pressure styles, for 3-Wire, 2 Heavy Wire, 2-Wire, 1-Wire, and Hi-Burst 2-Rayon Braid Hose, as well as Spiral Wire Suction Hose.

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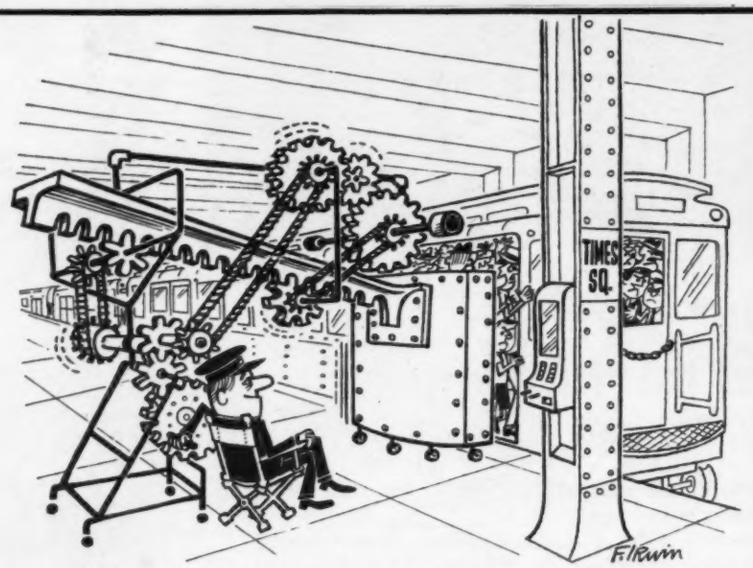

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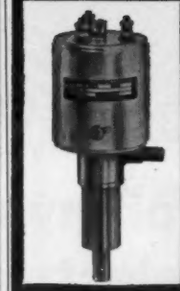

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Roller-Ramp Coordination

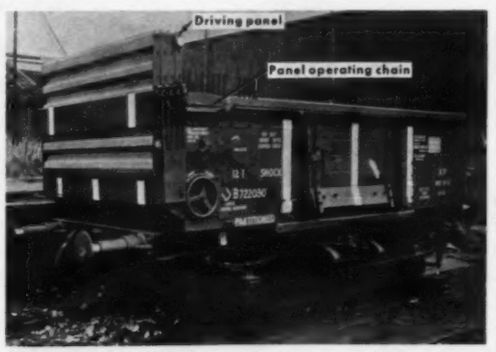
Ronald W. E. Martin, British Editor

Three sets of rollers, two of which are used in conjunction with two oppositely curved ramps, provide a simple mechanism for folding the panels of a railway car sliding roof. Design enables roof to be opened or closed with minimum weight-lifting, thus permitting hand operation.

Each panel is supported, when the roof is in the closed position, by two sets of rollers. One set engages longitudinal runways positioned on either side of the truck body; the second set is carried by an adjacent panel. In addition to supporting a panel, this second set also functions as pushing rollers. When opening roof, the end panel is driven longitudinally toward a panel-storage magazine positioned at one end of the car. This action displaces the whole roof, each panel pushing the preceding one by means of the pushing rollers.

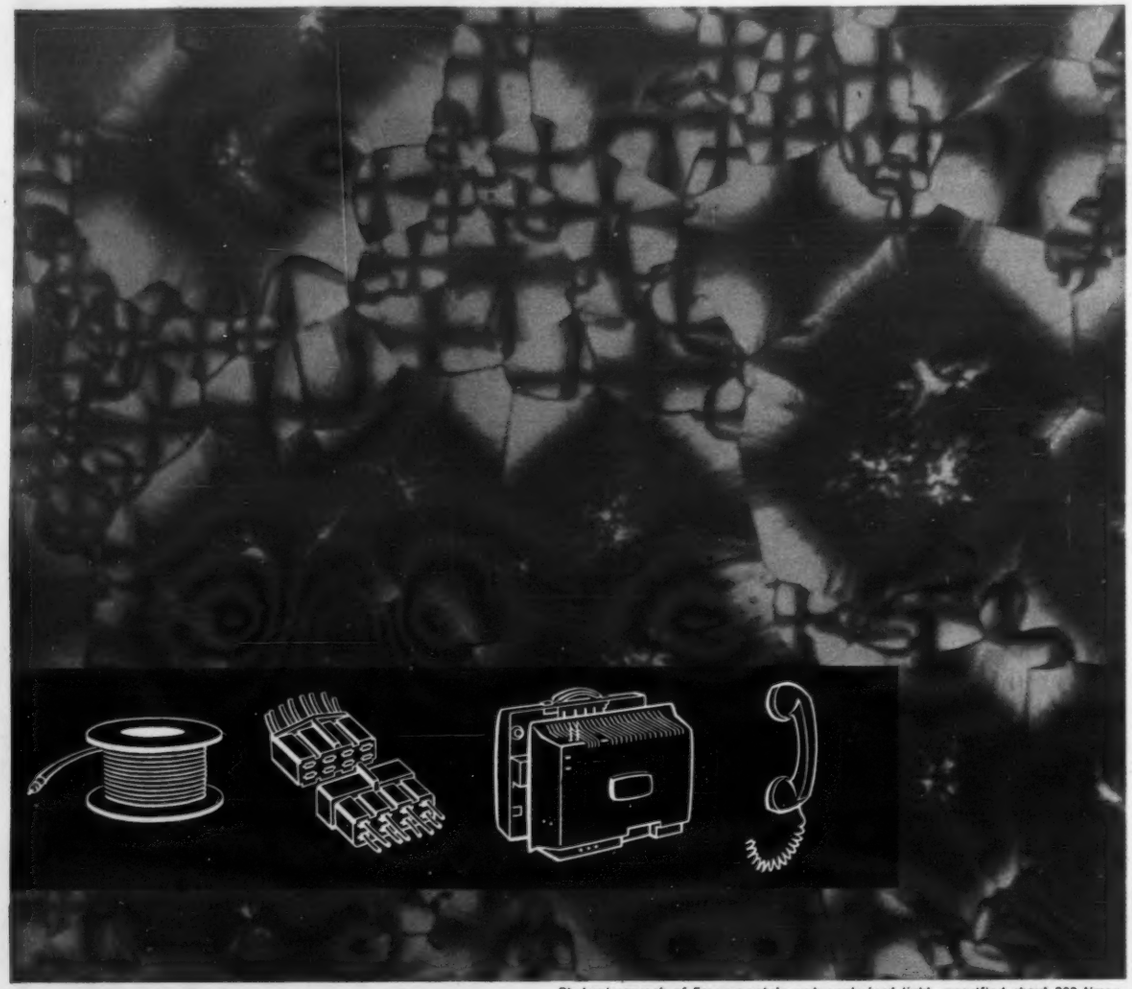
On approaching the magazine, the third set of rollers carried by each panel runs up side ramps to swing the panel into the vertical position. Simultaneously, the running rollers leave the runways and travel down guide ramps. These ramps insure that the swinging motion is made in a controlled manner.

To close the roof, the actuating mechanism is turned in the reverse direction, and the driving panel pulls the other after it by means of connecting chains between the panels. The sliding roof is manufactured by Rubery Owen and Co., Ltd., Darlaston, England, under license from MacGregor and Co., Ltd., London.



PANELS of sliding roof shown stowed in storage magazine after completion of opening operation. Slight reverse slope on swinging ramps makes panels self-parking when in closed position.

What's News in Plastics...



Photomicrograph of Escon crystals under polarized light, magnified about 300 times.

Escon® polypropylene for excellent electrical performance

Excellent electrical properties . . . combined with negligible water absorption and high heat distortion point . . . make Escon polypropylene particularly valuable for a wide range of electrical applications. Examples include electrical insulation, cable connectors, TV backs and telephone components. Escon polypropylene offers plastics processors a balanced combination of properties for high-speed, low-cost production. Expert technical assistance is always available. For more information write to Enjay, 15 West 51st Street, New York 19, New York.

Typical Escon Properties

water absorption, per cent	<0.01
melting point, °F	335
Vicat softening point (1 kg), °F	266-293
volume resistivity, ohm-cm	6.5×10^{16}
dielectric strength, volts/mil	
short time, ⅛" thickness	660
step-by-step, ⅛" thickness	650
dielectric constant, 10° cycles	2.0
dissipation factor, 10° cycles	0.0002-0.0003

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

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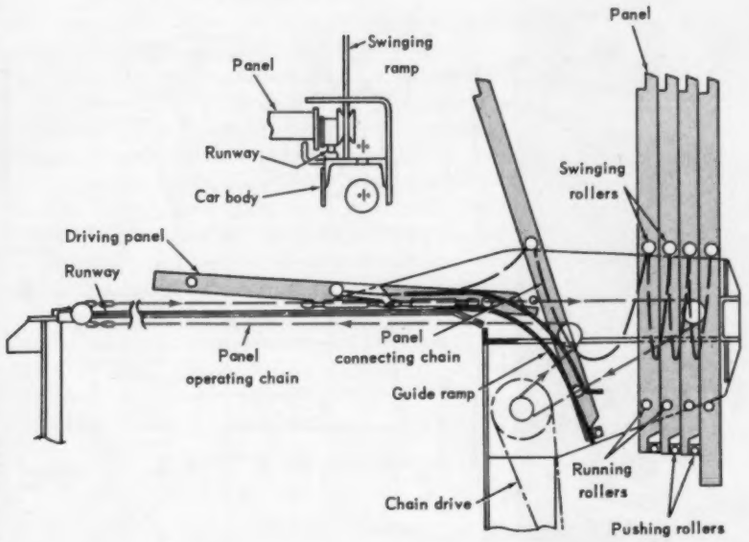
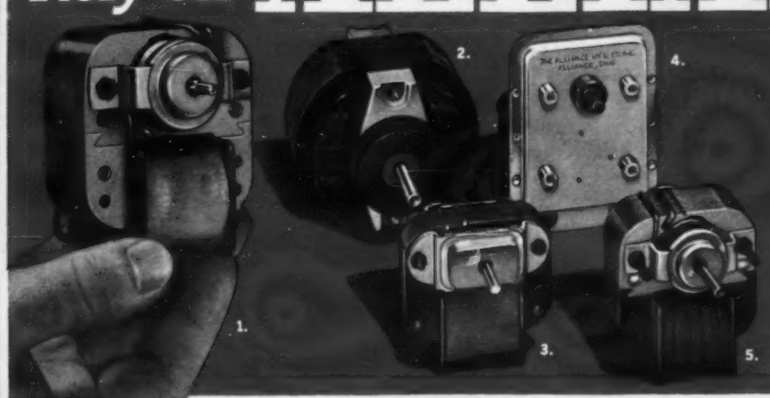
Folds Panels in Sliding Roof



SCHEMATIC shows details of panel swinging motion. Driving panel starts running over swinging ramp, pushing preceding panel toward storage position. At end of opening operation, all panels are stored in vertical position well outside car body. Drive is through two endless chains mounted in parallel and positioned on each side of body. Top sides of chains are fastened to end panel and are driven by hand-operated chain wheels. Since end panel is not supported at its outer end by adjacent pushing roller it is fitted with additional pair of running rollers.

Rely on ALLIANCE



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Model	Voltage	Starting Torque oz.-in.	Full Load Torque oz.-in.	Full Load Speed RPM	Full Load Input Amps	Full Load Input Watts	Weight
JSY 1101	117	1.0	0.4 (pull in)	3600	.285	18	1 lb. 14 oz.
L	117	6.5	8.0	3250	1.20	77	3 lb. 7 oz.
H	117	1.0	1.0	2500	.310	17	1 lb. 0 oz.
JSG	117	225	165	12-14	.490	25.5	1 lb. 7 oz.
JS	117	1.75	2.70	2900	.570	29	1 lb. 2 oz.

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The Alliance Manufacturing Company, Inc., Alliance, Ohio
(Subsidiary of Consolidated Electronics Industries Corp.)

ALLIANCE MOTORS

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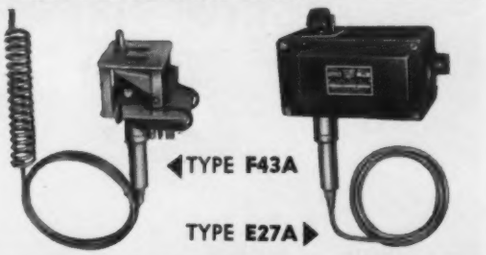
Dual Switch
REMOTE BULB TEMPERATURE CONTROLS **F43A | E27A**



The F43A and E27A are functionally similar units that are offered by UNITED ELECTRIC for applications where it is desirable to control two separate circuits at different temperatures by means of a single temperature control. The major differences between the two units are that the F43A is an uncalibrated, wide range, skeleton unit while the E27A is calibrated, has a narrow range, and is enclosed. If desired, the E27A can be modified to have a wide range.

Temperature Ranges . . .	F43A — up to maximum limits of −150° to +150°F., 70° to 370°F., or 100° to 650°F. E27A — 100° or 200°F. spans between −150° and +650°F. limits.
On-Off Differential	Approximately 1.0°F. or 2.0°F. depending upon the model.
Switch Ratings	Up to 15 amps. at 115 or 230 volts A.C. 20 amps. A.C. or D.C. switches also available.
Switch Types	N.O., N.C., or Double Throw — no neutral position.
Adjustments.	F43A — slotted range adjustment screw on top, uncalibrated settings. E27A — external knob and pointer, calibrated settings. In each unit, switch may be adjusted individually to provide for approximately 15°F. max. span between switch settings. Span remains constant over entire range.
Electrical Connections . .	Via attached terminal blocks.
Capillary Tube Length . .	6-foot standard length. Other lengths available.
Mounting	F43A — via tapped holes in top plate. E27A — via mounting ears or tapped holes.

UNITED ELECTRIC *manufactures a complete line of temperature, pressure and vacuum controls. Standard units can be modified or custom-built units made to your specifications. Additional information on temperature controls is available upon request.*

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Three Saginaw b/b Screws and one Spline enabled astronaut Shepard to control Mercury capsule in space flight

No margin for malfunction

ABSOLUTE RELIABILITY was vital in the functioning of the Saginaw Ball Bearing Screws and Splines incorporated into the control system of space capsule Mercury. Three b/b screws extended a periscope out of the capsule and retracted it, opened and closed the door covering the periscope's eye. One b/b spline controlled the capsule's pitch, yaw and roll permitting the astronaut manual control of the space vehicle in flight.

Perhaps few, if any, of your designs will ever have to meet comparable crushing G forces. Nevertheless, you get similar reliability with every b/b screw or spline that bears the Saginaw trademark. Over 58,000,000 have been produced and successfully used in a wide variety of applications.

Other actuation advantages of Saginaw b/b Screws:

HIGH EFFICIENCY exceeding 90% of input;
LIFE predictable within 10%;
STEPLESS CONTROL over the entire length of the stroke;
HIGH REPEATABILITY of any position;
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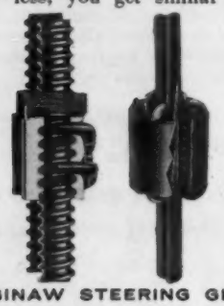
EASE OF SYNCHRONIZING multiple units;
SMALLER COMPONENTS in the power source and drive transmission, and
UNIFORM FEED RATE under varying load conditions.



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Saginaw ball/bearing SCREWS and SPLINES

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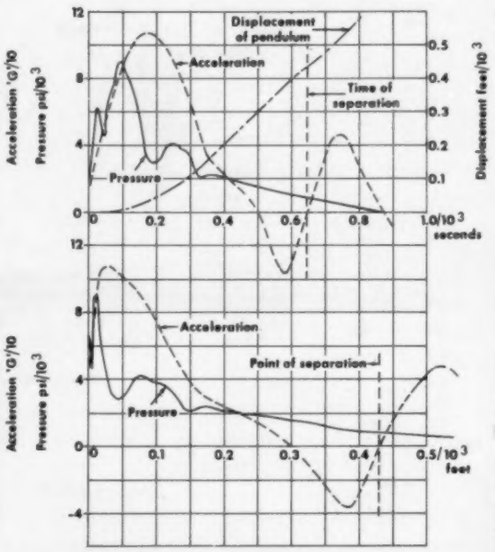
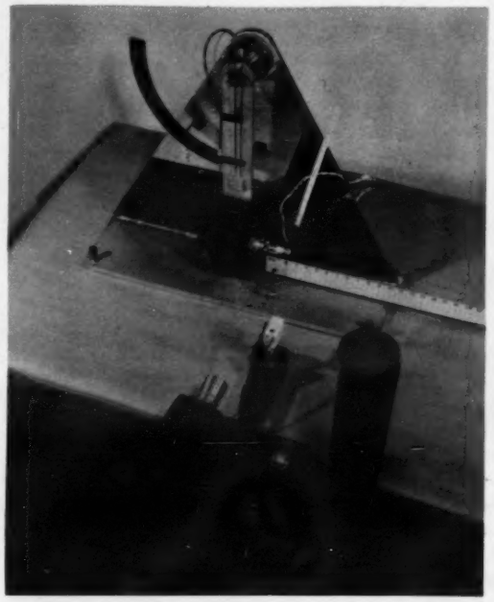
Pendulum Restrains Motion

Edward W. Schrader, Western Editor



TYPICAL CURVES of acceleration and pressure versus displacement, and of acceleration, pressure and displacement versus time.



PENDULUM AND SEPARATION NUT installed for test. High-speed photo setup and photocell are used for determining component velocity and separation time.

to Measure Separation Reliability

Go/no-go tests of an explosive separation system would require more than 60,000 shots to obtain a satisfactory reliability figure with a 95 percent confidence level. To overcome this high cost of testing, separation system designers developed a pendulum test to measure the available force margin.

By measuring the degree of success of each shot, and by applying statistical methods of reliability to these results, the number of shots required to obtain a 99.995 percent reliability at a 95 percent confidence level may be reduced to the order of 200 shots.

The motion of a pendulum is inherently restrictive; from rest it moves in only one direction. Therefore, the work the pendulum acquires in the form of kinetic energy may be measured.

Margin is defined as:

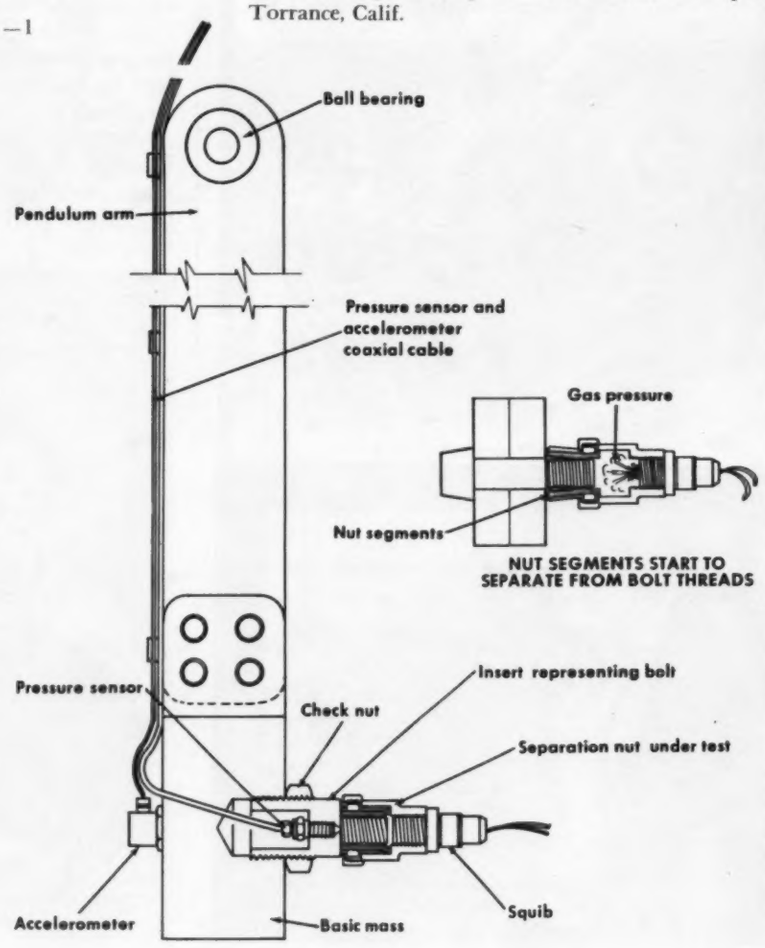
$$\text{Margin} = \frac{\text{Pressure energy}}{\text{Loss energy}} - 1$$

or

$$\text{Margin} = \frac{\text{Pressure energy}}{\text{Pressure energy-acceleration energy}} - 1$$

Instead of energy, margins are calculated from the impulse ratios (integral of the force-time relation), which can be measured by a planimeter integration of Polaroid photographs; for the particular nut design, the impulse margin shows a 1:1 correspondence with the energy margin. Other nut designs require that a comparison be established between the energy and the impulse margins so the more easily obtained impulse margins may be used for the energy margins.

The pendulum method for measuring nut separation is a design development of the Hi-Shear Corp., Torrance, Calif.



PENDULUM with large basic mass contains accelerometer and pressure sensor to measure work absorbed by pendulum system above pressure work performed in separation of nut. When explosive bridgewire squib fires, gas pressure causes separation nut to back off of insert (representing bolt) until nut segments separate from bolt threads. Nut then is fully released from both, and pendulum mass is accelerated. Pendulum mass also is accelerated by excess force (if any) prior to actual separation. Complete separation occurs at approximately 0.006 inch of pendulum deflection. Pendulum continues to move in its restrained path to absorb impulse imparted to it by explosion after separation.

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Seamless drawn cylindrical container of 22 gauge steel.

Seamless drawn rectangular container of 20 gauge, type 302 stainless steel.

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(B.S. — M.E., University of California)

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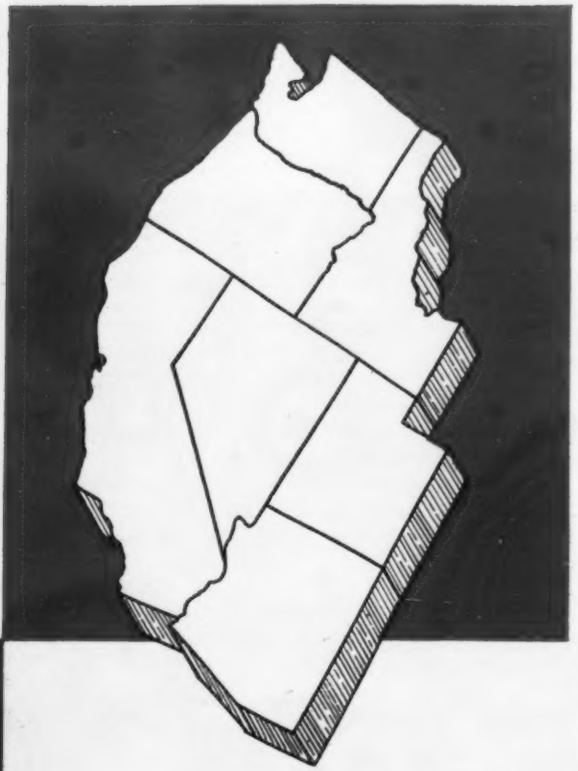


for Design News

Before digging out story details, Schrader gathers important background information.

Ed insists on getting information for his articles first-hand... all Design News Regional Editors do!

Ed is always on the move in search of new Design Ideas. It's his job to find them, to select pertinent facts, drawings and background material... and then to report them accurately and concisely to you, the Design News Reader.

Of course, many of his leads come by phone or letter from men like yourself. These he follows up in person.

Do you have an interesting Design Idea now past the preliminary design stage? If so, contact **Edward W. Schrader, Western Editor, Design News, 6399 Wilshire Blvd., Los Angeles 48, Calif., OLive 3-9720.** He'll be glad to discuss a possible article with you.

Engineer-editor Schrader gets the heart of Design Idea with men who made the news.

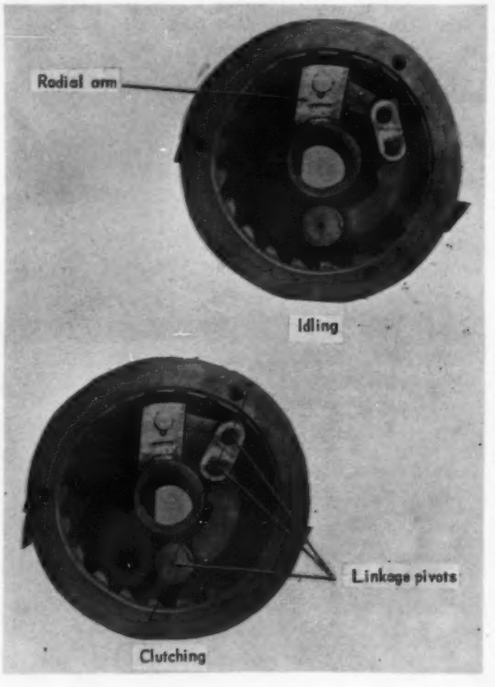
180-Deg Drive Starts and Stops

Celestino O. Lubatti, Italian Editor

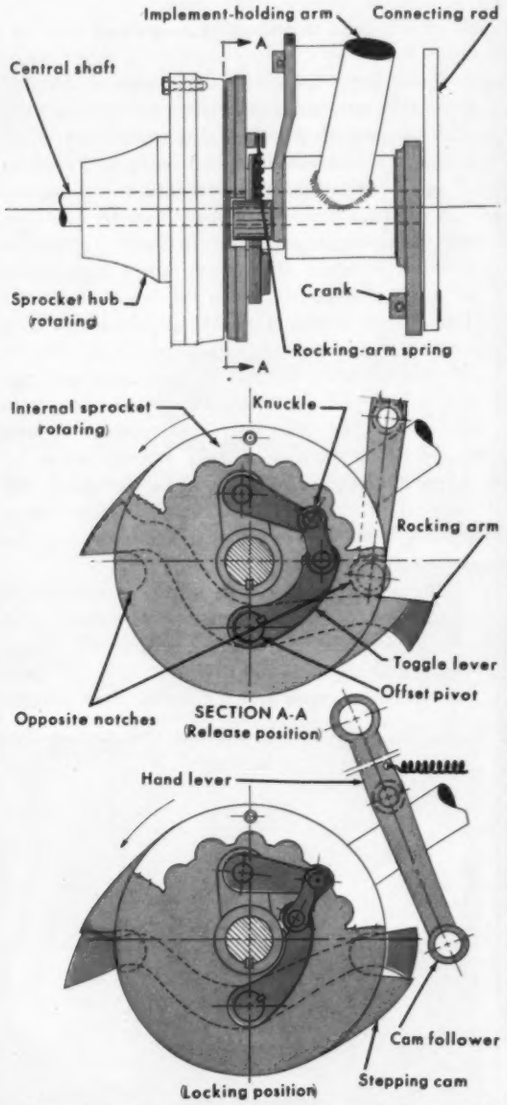
Sinusoidal speed changes of a crank drive in the implement lifter of an agricultural machine reduce wear and shock. Slow starting and stopping for each 180-deg turn of the crank minimizes inertia and stresses. Dead centers establish upper and lower limits of the vertical implement-stroke.

A spring-loaded rocking arm engages the stepping cam with a constantly rotating internal sprocket. An offset pivot on the stepping cam carries the rocking arm and an expansible knuckle. After 180-deg rotation of the whole drive, the cam follower acts against one end of the rocking arm and causes retraction of the knuckle. The cam follower is manually disengaged from the cam and rocking arm to re-expand the knuckle and start next cycle.

The 180-deg drive is rotated by one of the trailing wheels of the agricultural vehicle. Except for the manual triggering of the rocking arm, implement lifting and lowering is entirely power driven. The patented unit, a design by Giuseppe Pavesi, is used with wheeled plows, rotary hoes and cultivators manufactured by Costruzioni Ferri & Simoni, Poggio Rusco, Mantova, Italy.



Smoothly without Shock Absorbers



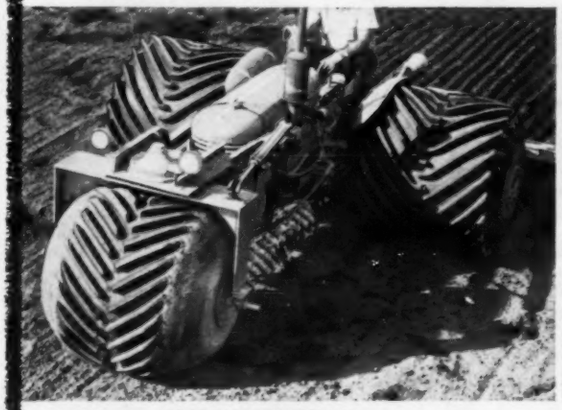
INTERNAL SPROCKET rotates continuously on central shaft. No power is transferred to crank when hand lever keeps rocking arm in "release" position (dotted lines) and holds stepping cam stationary. When cam follower is swung out of rocking arm trajectory, rocking-arm spring causes knuckle expansion to clutch internal sprocket. This, in turn, rotates cam and crank which are keyed to and connected by central shaft. After 180-deg turn, rocking arm impinges against cam follower and swings back to "release" position to disconnect crank drive. Hand-lever spring forces cam follower into cam notches for locking. Connecting rod moves in alternate directions to shift implement (not shown) up and down.

GOODYEAR

Terra-Tires solved problems on this equipment— How can they help you in your design?

Problem: MOBILITY
Solution: Terra-Tires by Goodyear. Their wide tread, low inflation pressures and high flotation let this truck, owned by Shell Oil Company, easily pull free of a deep bog during an oil exploration.

Problem: FLOTATION
Solution: Terra-Tires by Goodyear. An Indiana company put Terra-Tires on this scraper to prevent delays caused by equipment miring down. Result: Faster peat harvesting at lower cost.



Problem: NON-COMPACTION
Solution: Terra-Tires by Goodyear. A racetrack that's uneven can damage thoroughbreds' legs, so Santa Anita uses tractors with Terra-Tires to condition track after a rain without compacting ground.

Problem: CARGO PROTECTION
Solution: Terra-Tires by Goodyear. Bananas bruise easily, so United Fruit "floats" its fruit from farm to railhead on equipment fitted with Terra-Tires, which also permit all-season hauling.

If you're designing a "go-anywhere" vehicle – or one that must baby its cargo or the ground it goes on—Terra-Tires by Goodyear should be a part of your design. They're available in a wide range of sizes and treads. Let us know what you're driving at—or on—or over, we'll be glad to suggest a design to solve your problem. Write Goodyear, Aviation Products Division, Dept. J-1724 Akron 16, Ohio, or Los Angeles 54, California.

Lots of good things come from GOODYEAR

Terra-Tire—T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

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Introducing a new type of "Armalon"

new "Armalon" FEP-fluorocarbon resin coated glass fabrics

After extensive development and testing, Du Pont now can offer "Armalon" FEP-fluorocarbon resin coated glass fabrics. The FEP resin has unique properties that enable this new "Armalon" to find applications in areas not appropriate to our regular TFE line of "Armalon".

Outstanding advantages of new "Armalon" FEP

- Uniform porosity resistance
- New lower melt point for easier lamination
- Good heat resistance
- Extreme toughness
- Abrasion resistance
- Excellent electrical properties over a wide range of temperatures and frequencies
- High degree of chemical inertness
- Smooth, anti-adhesive surface with anti-stick qualities

Comparison of properties of new "Armalon" FEP and "Armalon" TFE

PROPERTIES	FEP 503-108	TFE 403-108	FEP 505-112	TFE 405-112	FEP 506A-116	TFE 406A-116	FEP 510-128	TFE 410-128
Breaking Strength	65 x 40	45 x 35	130 x 65	75 x 60	160 x 160	90 x 90	260 x 220	200 x 175
Tear (Elmendorf)	16 x 6	10 x 5	21 x 8	15 x 10	13 x 14	12 x 12	49 x 39	40 x 40
Moisture Absorption	.23	.64	.18	.68	.30	.32	.276	.10
Burst	150	25	200	25	380	100	410	100

Characteristics of new "Armalon" FEP

The "Teflon" FEP-fluorocarbon resin coating on "Armalon" FEP gives this new material several outstanding properties (not provided by "Armalon" TFE). For example, the FEP resin has a lower melt point (545°F. to 563°F.) than the TFE resin. This recommends the use of "Armalon" FEP as a coating on glass fabrics that are to be heat-sealed. In addition, FEP dispersion-coated glass fabrics have lower permeability, greater breaking strength and lower moisture absorption than "Armalon" TFE.

You may want a material that doesn't crack when creased under moderate pressure. "Armalon" FEP won't. There is no known solvent for its FEP resin coating, and it is unaffected by aqua regia and all known chemicals except molten alkali metals. Corrosive materials and atmospheric conditions have no effect on it.

"Armalon" FEP remains flexible after long exposure to high temperatures, and pliable at temperatures lower than -100°F. Of particular significance are the improvements in burst strength and moisture absorption in the higher resin, lower glass qualities (see Qualities 503-108 and 505-112).

Suggested uses for new "Armalon" FEP

An important use for new "Armalon" FEP is in the wrapping and fusing operations for pipe covering, roll covering and chemically resistant containers. We also recommend these new materials for gaskets and specialized diaphragms, because of their satisfactory levels of uniform porosity resistance.

Industries that should find new "Armalon" FEP useful are aircraft, chemical, food processing, packaging, paper, plastics, printing, rubber, textile and various other industries.

FOR EXAMPLE: Conveyor belts used in baking, candy and food industries where sanitation and ease of release are important—Non-sticking covers for heat-sealing bars on packaging equipment—Diaphragms for regulators and control instruments where heat and chemical resistance are required. These are a few suggested uses for new "Armalon" FEP—there are many, many more. What application does this new product suggest to you?

For complete information on new "Armalon" FEP, its application and uses, write: E. I. du Pont de Nemours & Co. (Inc.), Fabric Sales, Wilmington 98, Delaware.

DU PONT "ARMALON" COATED GLASS FABRICS

BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

"Armalon" is Du Pont's trademark for its FEP and TFE fluorocarbon resin-coated fabrics and laminates.

Circle 20 on Reader-Service Card for more information

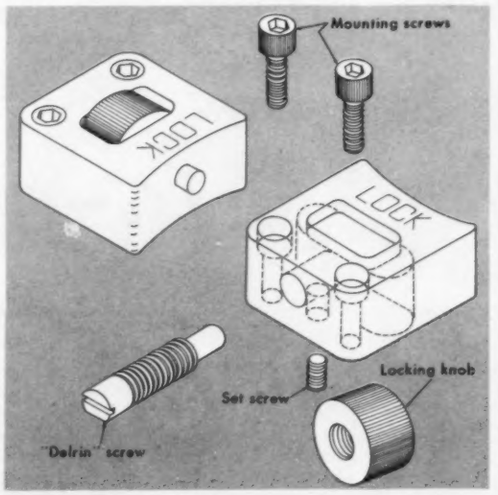
'Easy-to-Read' Positioner

Victor W. Wigotsky, Eastern Editor

A miniature, dual-speed drive uses a reverted gear train and concentric dials for compactness, high positional accuracy and readability. Unit provides precise angular positioning and readout of small rotary electromechanical components.

A compact drive, capable of rapidly positioning the driven component in small, repeatable increments, while still maintaining a high degree of direct readability, were the basic objectives. These were achieved by the combination of a reverted gear train and concentric dials. The reverted gear train permits in-line input and output shafts and thus reduces overall gear train center distance. The gear train consists of two stages which provide a 10:1 velocity ratio between the concentric inner and outer dials. Different tooth pitches on the first- and second-stage gearing keep the center distance equal for the in-line shaft arrangement.

The objective of a high degree of readability is achieved, without the use of a vernier, with two concentric dials. A 2-1/2-inch-dia outer "fine" dial contains 100 divisions. The 10:1 gear ratio between outer and inner dial then permits



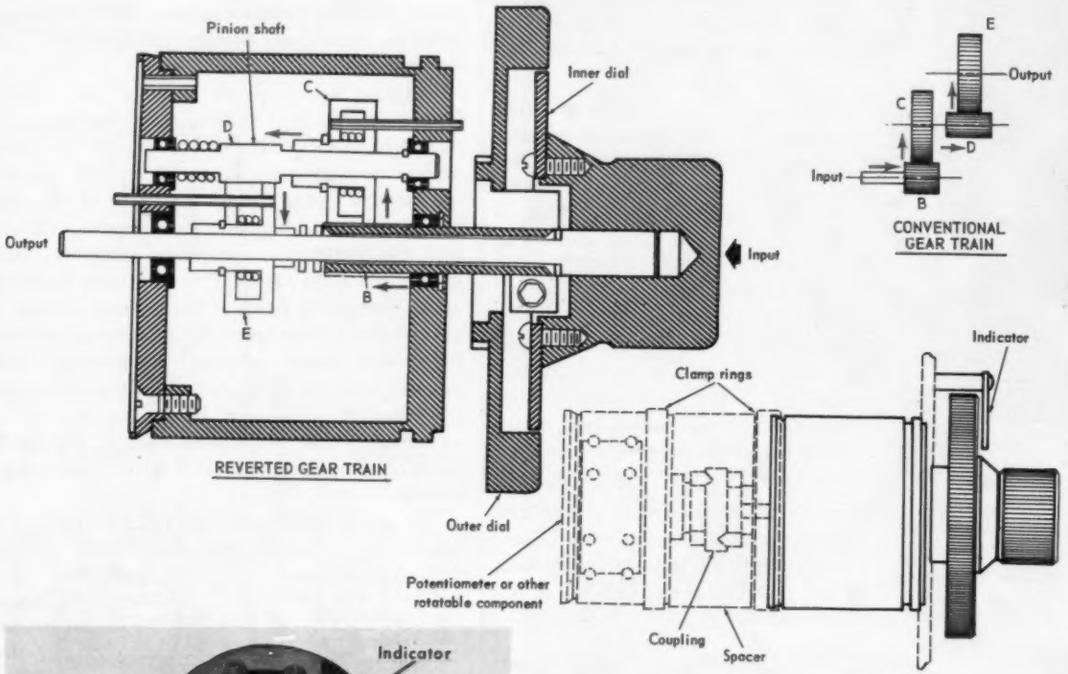
DIAL LOCK MECHANISM axially locks outer dial securely on exact setting. Turning floating thumb knob to left causes axial movement of "Delrin" screw and jamming against knurled outer dial. Set screw bears against flat portion of "Delrin" screw to prevent rotation inside knob. Location of mechanism minimizes accidental movement of dial when using lock.

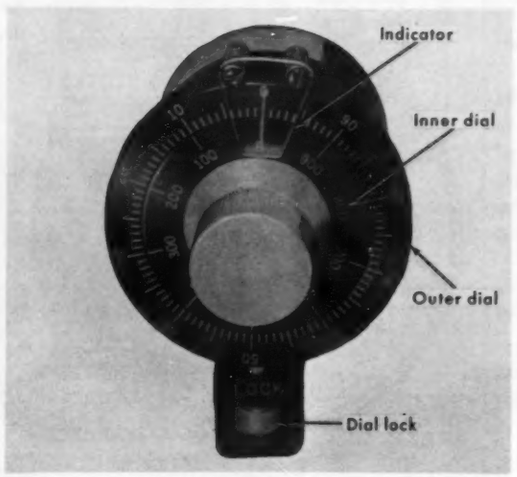
Uses Concentric Dials and Shafts

direct reading of one part in 1000. To accomplish the same readability with a single dial, containing 1000 divisions with similar spacing, would require a dial approximately 23 inches in diameter.

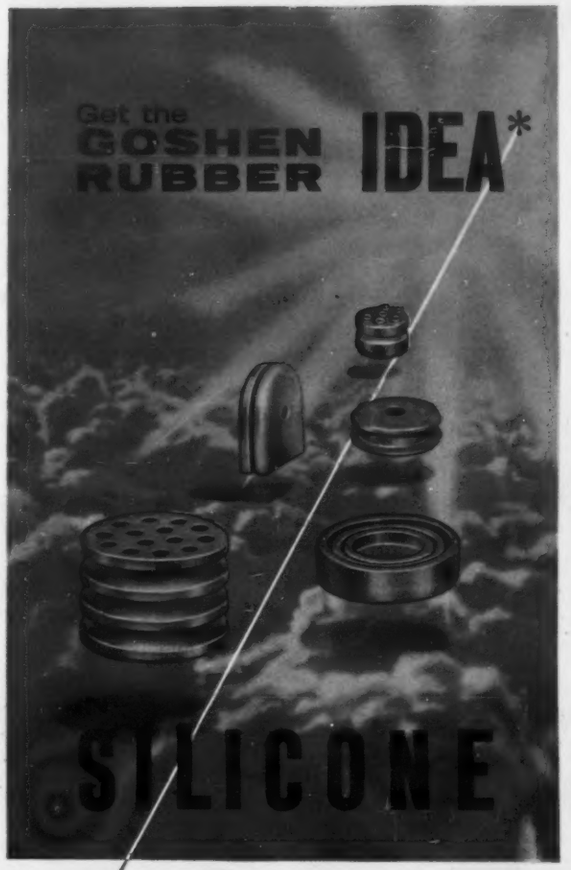
Another feature of the shaft positioner and indicator is a dial lock mechanism. This consists of an anodized aluminum block in which a knurled thumb knob floats. Rotation of the locking knob causes a "Delrin" screw to move axially into the knurled portion of the outer dial. This action locks the dial securely without disturbing the setting. The "Delrin" screw functions as a jam nut and provides a self-lubricating, pliable characteristic which prevents marring of the outer dial surface.

The DSD-40 miniature, dual-speed precision drive was developed by the Mechanical Products Div., Technology Instrument Corp. of Acton, Mass.





COMPONENTS, such as potentiometers, resolvers and synchros, can be positioned within 12 deg of arc. Reverted gear train, concentric shafts and dials provide desired compactness. In first stage, gear B (24 teeth) and gear C (60 teeth) have pitch of 96, while in second stage, gear D (21 teeth) and gear E (84 teeth) have pitch of 120. Ten turns of gear B then equal one turn of gear E to provide 10:1 velocity ratio. In-line positioning of input and output shafts is accomplished by different pitches on first and second stage to keep center distance equal. Rotation causes outer dial to rotate at 10 times speed of inner dial (since gear train now drives back through itself), or in a 1:1 ratio with outer shaft. Rotation of outer dial, by turning knurled outer edge, causes inner dial (directly connected to output shaft) to rotate at 1/10 the speed. Thus, inner knob and dial rapidly "rough" positions output shaft while outer dial permits "fine" positioning within compact housing.



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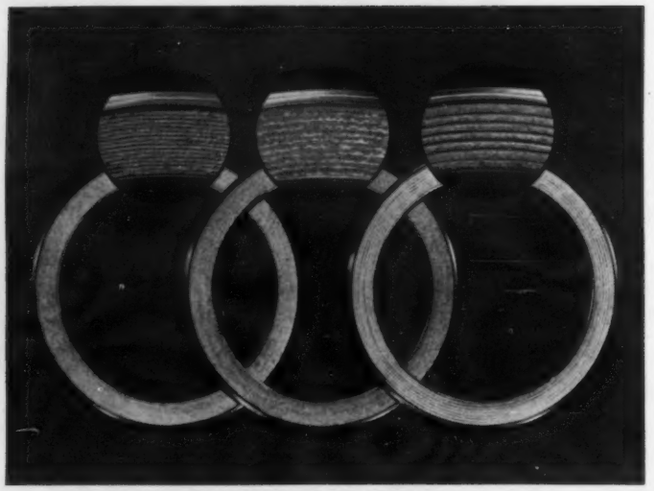
GASKETS
in Design
Engineering



Exacting control of gasket density is obtained by varying the number of metal plies and filler material to seal a specific pressure.

Controlled density is the reason why Garlock *Guardian Gaskets offer you unusual sealing ability.** A series of V-shaped metal plies alternated with layers of filler form the "body" of GUARDIAN spiral-wound gaskets. The proper selected thickness of filler material and preformed metal, the number of laminations of filler and metal and the correct tension of filler and metal while being formed into a gasket are factors engineered to achieve the proper gasket density.

This controlled density—combined with the special V-shaped metal plies—allows the gasket to "breathe." Thus, a tight seal is effected at all times despite equipment or line expansion and contraction. In no other type of gasket is it possible to vary the compressibility to meet different pressure and bolt load requirements.

Complete range of sizes, shapes and wide temperature range are more reasons for specifying Garlock GUARDIAN Gaskets . . . 1/16" thickness up to 6", 1/8" up to 30", .175" up to 60" and 1/4" thick up to 60" depending on flange width. For temperatures up to +1900°F. with ceramic filler material.

Type CR GUARDIAN Gaskets are furnished with a cadmium plated centering ring for corrosion resistance and prolonged shelf life. Centering ring also is marked with the pressure series —assuring application of correct gasket density for specific pressure.

Convenient local stocks of most standard sizes are maintained at Camden, New Jersey, Cleveland, Ohio, Houston, Texas and San Francisco, California, for quick delivery.

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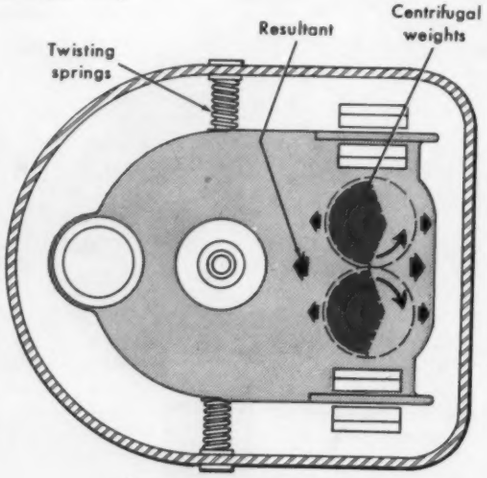
Mechanical Resonance Provides Inexpensive Radar Scanning

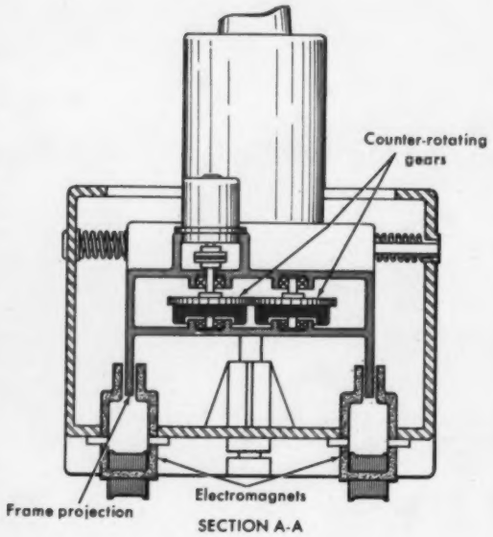
Celestino O. Lubatti, Italian Editor

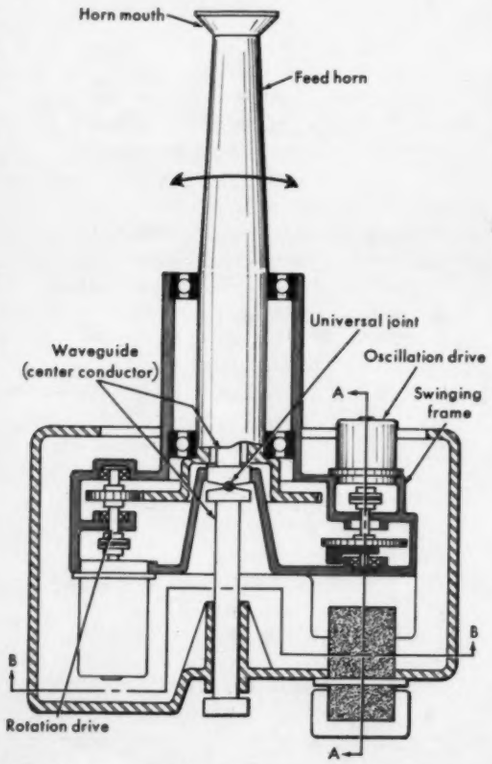
Combined action of centrifugal weights and twisting springs yields constant-frequency harmonic forces for the scanning movement of a radar feed horn. Unlike other scanning drives, this vibrator is entirely free of backlash and simple in design. Variable damping by electromagnets permits accurate adjustment of the scanning angle included by the radar beam. Resonance between oscillating unit and centrifugal weights minimizes power requirements and stresses.

Rotating speed of the weights and natural frequency of the vibrating unit are predetermined to make oscillations practically harmonic with a normal scanning movement of about 5 cps. Almost linear variation pattern of the various parameters (applied force, spring rigidity and electrodynamic damping) simplifies both design and final setup. The feed horn oscillates about side pivots holding the twisting springs. It also rotates at high speed, as in common practice, for proper beam pattern. A universal joint aligned with the side pivots allows oscillation of the center RF conductor. Electromagnets around swinging frame projections permit change of scanning amplitude by varying the magnetizing current.

The design, developed by Prof. Carlo Calosi of Selenia SpA, Rome, Italy, is utilized by the Italian Navy.







MECHANICAL RESONANCE between alternating resultants of centrifugal forces and natural response of spring-balanced frame permits wide scanning angle in a plane containing horn axis. This plane can be displaced by antenna aiming equipment (not shown). Feed horn illuminates microwave reflector (not shown) facing it. Centrifugal weights are attached to counter-rotating gears, driven at equal speed by electric motor. Separate drive for 3000-rpm horn rotation is placed opposite to vibrator for proper load distribution.

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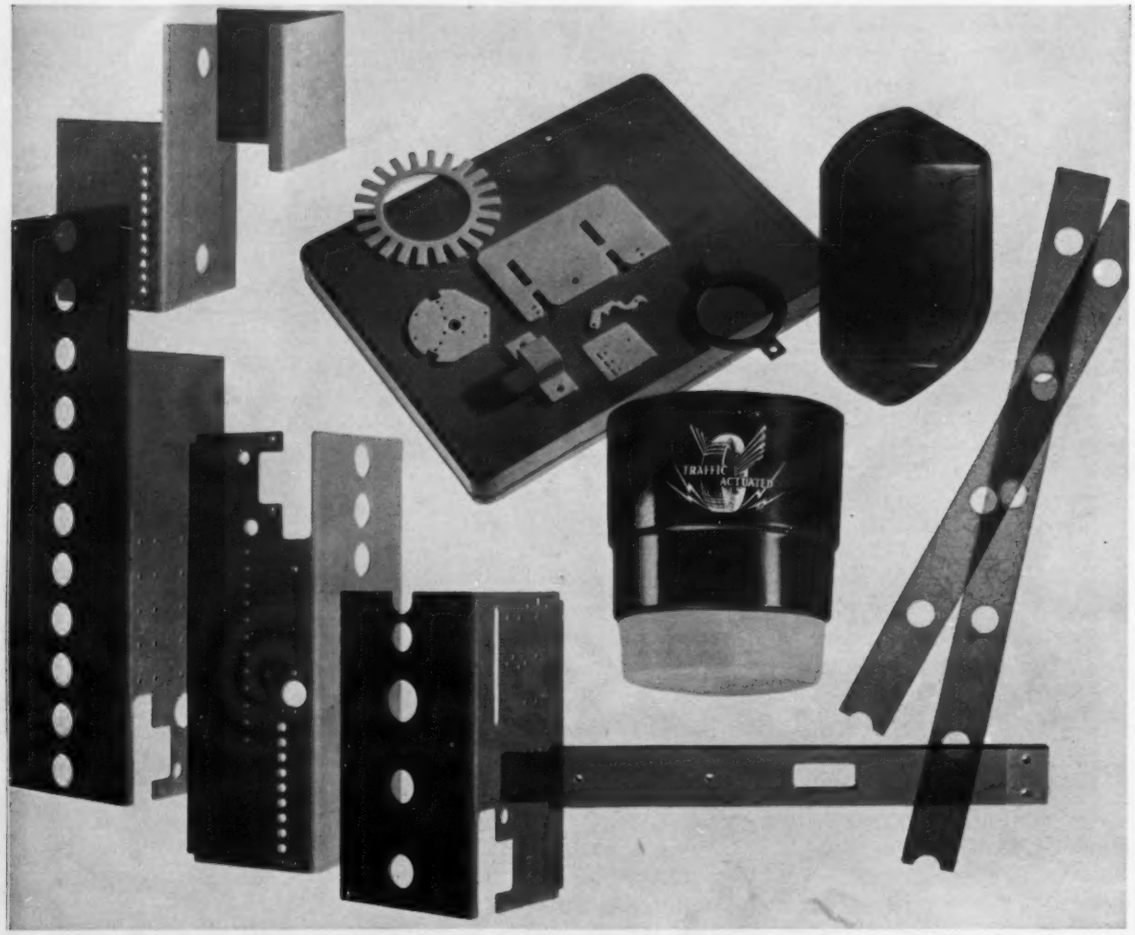

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Added to the inherent toughness and strength of polyester-glass are good electrical and thermal properties, weather resistance—and flame retardance if you need it.

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Sudden Air Expansion

Edward W. Schrader, Western Editor

An expansion heater is essentially a step-type burner. Air is introduced through the inlet duct of the heater and flows without restriction into a larger duct serving as the combustion chamber. Fuel is injected in the step section between the smaller inlet duct and the combustion chamber. A hydrogen-air system starts combustion.

A water-cooled orifice or turbulator installed in the combustion chamber provides a uniform temperature distribution at the outlet. It also gives a higher combustion efficiency.

The heater utilizes such fuels as propane, 80 octane gasoline, JP-4, toluene, benzene, rocket fuels and waste fuel mixtures.

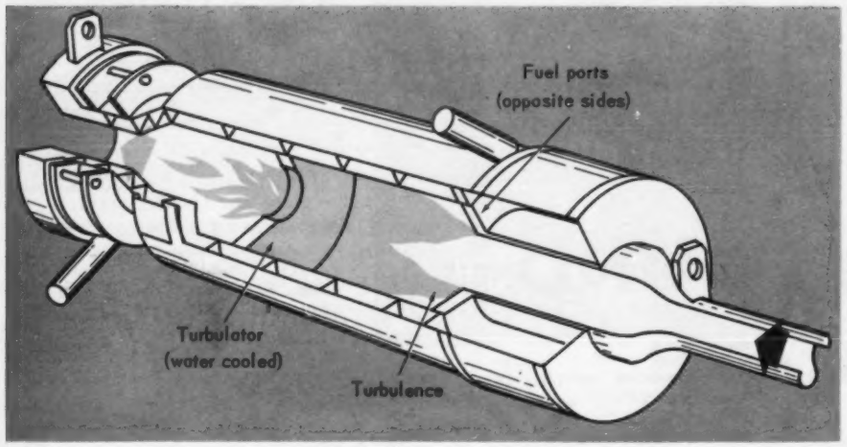
The device has a wide range of stable burning. The ratio of fuel to air can be varied from 53 at low-combustion chamber air velocity to 12 at high-combustion chamber air velocity. These large ratios are attributed to the fuel injection into the step of the burner. Here the fuel can burn at approximately stoichiometric ratios as it crosses the flame front.

Rich and lean mixtures for blowout limits with JP-4 fuel and air are approximately 0.15 and 0.010, respectively. Because of the step configuration, velocity blowout limits are high even when compared to turbojet and ramjet burners.

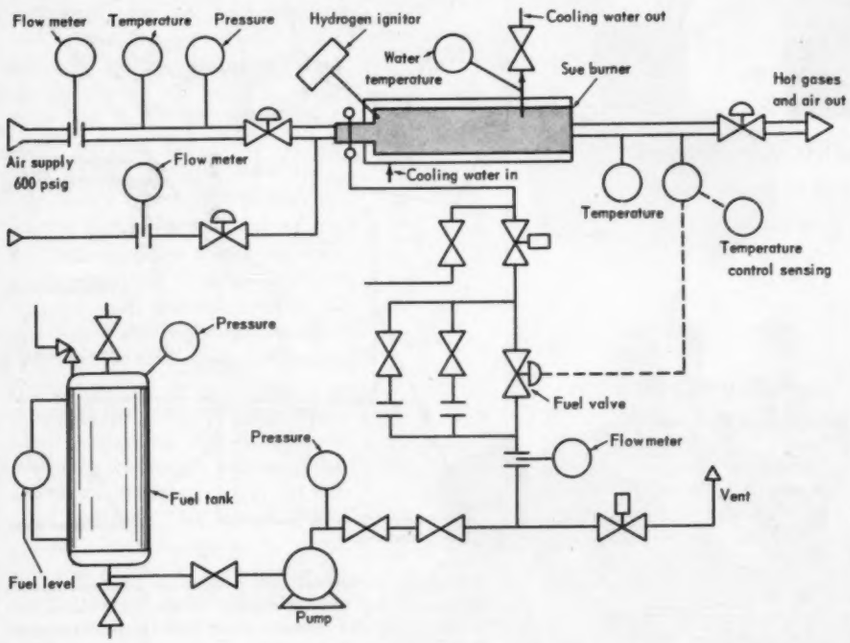
The fuel/air ratio based on total oxidizer flow is much below the theoretical lean limit for the fuel being used. This ratio can be 1/30 of the theoretical minimum. Outlet vitiated air temperatures as low as 150F have been maintained continuously with an inlet air temperature of 70F.

The sudden expansion burner/heater system, called the SUE, is a design development of The Marquardt Corp., Van Nuys, Calif. Inventors were Robert Babbitt and John Clure.

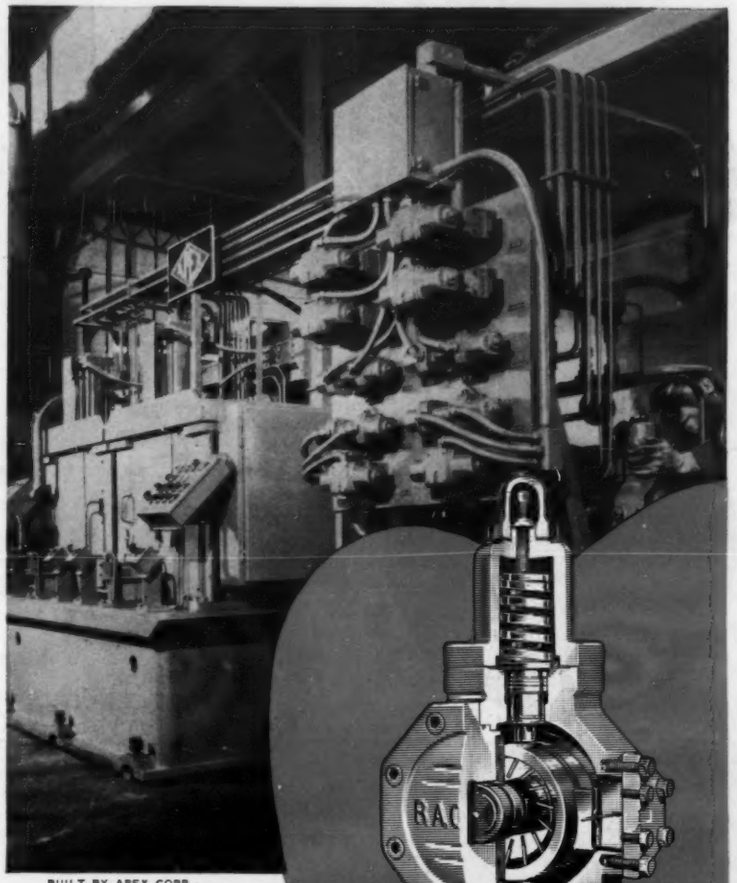
in Heater Permits Low Fuel/Air Ratio



SUDDEN EXPANSION HEATER uses water-cooled orifice to improve uniformity of temperature distribution across exit. Turbulator in combustion chamber is used to increase efficiency of combustion. Combustion efficiencies in excess of 98 percent have been measured. Temperatures to 5600F have been measured on test items placed in exhaust stream.



SCHEMATIC of burner system. Ignition is started at low pressure and flow conditions. Fuel and air flows then are adjusted concurrently to desired setting. During this stage, combustion chamber temperature is monitored continuously. Heater pressure levels from 20 to 550 psig are commonly employed.



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the HEART of this impregnating machine is a RACINE MODEL 6FA PUMP

SEAL POROSITY IN 106 TRANSMISSION CASES EVERY HOUR

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RACINE **Racine Hydraulics & Machinery, Inc.**
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HYDRAULICS DIVISION

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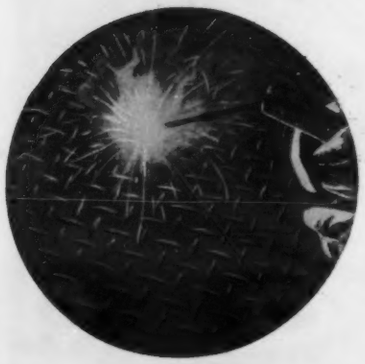

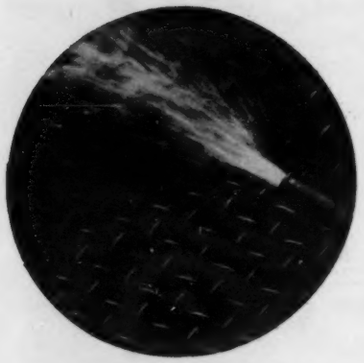

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Circle 26 on Reader-Service Card for more information

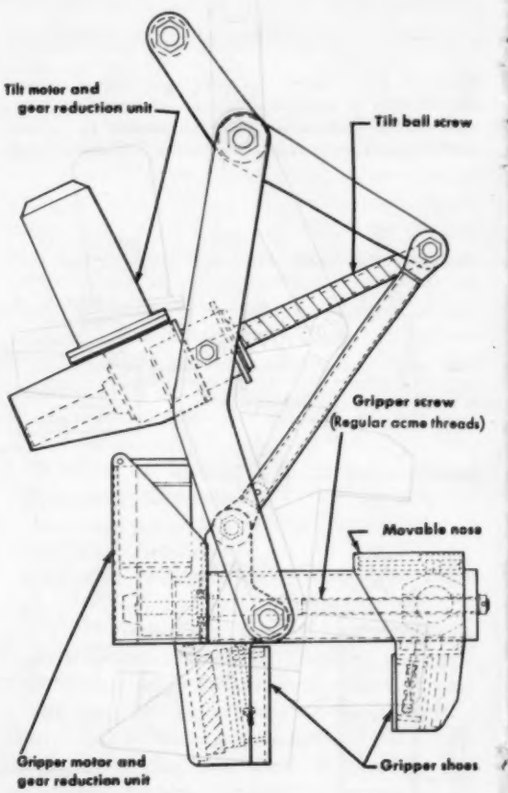
Toggle's Self-Energizing Action Provides Powerful Mechanism

E. J. Stefanides, Central States Editor

PROBLEM:

Design a crane-suspended device for the lifting, tilting and stacking of aluminum, brass and steel coils. The unit must be light enough to be used in conjunction with existing coil-handling hoists and compact enough to dive between stacked coils for retrieval. Yet it must be powerful enough to overcome the moment of the suspended coil during the tilting operation and to grip the heavy coil securely when in the vertical position.

SOLUTION:


Tilt motor and gear reduction unit
Tilt ball screw
Gripper screw (Regular acme threads)
Movable nose
Gripper motor and gear reduction unit
Gripper shoes

TILTING to vertical coil position is accomplished by driving tilt ball screw to expand linkage. This moves coil's center of gravity beneath crane hook suspension point. Initial grip is developed by driving sliding jaw screw to close jaws. Self-energizing action tightens grip when lifted. When load is released, springs return shoes. To return coil to horizontal position, linkage is collapsed by ball screw.

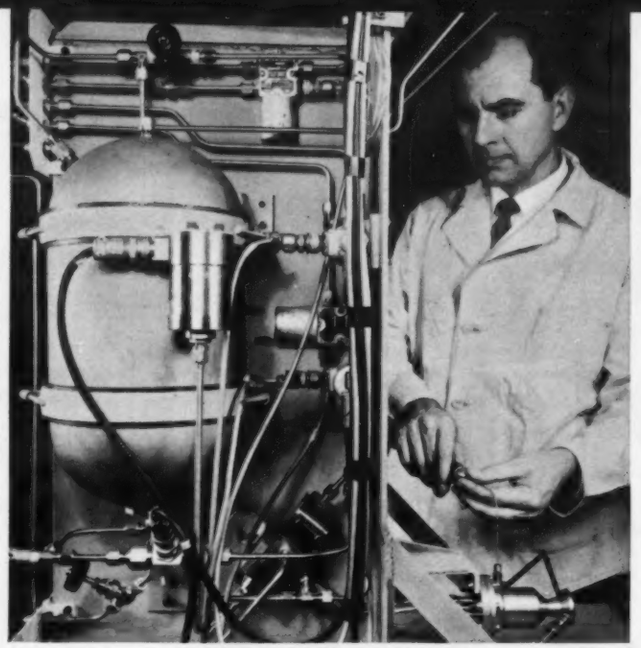
COIL-TILTING DEVICE is actuated by two separate electric-motor-driven screws. Unit shown weighs 1750 lb, is capable of lifting, tilting and stacking 6000-lb coil.

A four-bar linkage tilting mechanism powered by an electric-motor-driven ball screw and equipped with a self-energizing-type coil-gripping device. In operation, the linkage forms a powerful toggle as the coil approaches the horizontal position. The self-energizing gripper uses the coil's own weight to develop its gripping power.

Going from eye-horizontal to eye-vertical, the center nose of the gripping device is inserted into the eye of the coil. The gripping jaws then are closed by an acme screw driving the other sliding nose, taking up the loose coils. The coil is lifted clear of the pallet by the hoist and the tilting mechanism drive motor is actuated to extend the linkage and tilt the coil into an eye-vertical position. In this position, wedges mounted on inclined planes within the jaws use the coil's weight to develop the coil-gripping force. During stacking, the jaws automatically disengage, releasing the coil when the stack takes up the coil's weight. The movable jaw can be driven readily to the open position. In the eye-vertical to eye-horizontal operation, the procedure is reversed.

This equipment is designed and manufactured by the American Forge & Mfg. Co., McKees Rocks, Pa.

Circle 27 on Reader-Service Card



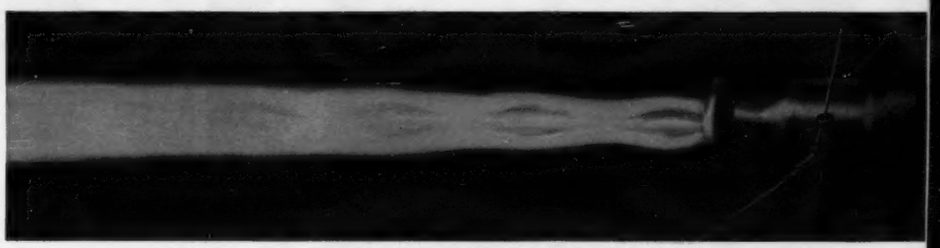
Special test facilities developed by Vickers Research and Development teams are used to evaluate nozzle designs, fuels, controls, instrumentation, etc. This setup is used in hypergolic bipropellant studies.

CAPABILITY
is spelled
a-t-t-i-t-u-d-e
c-o-n-t-r-o-l

Selection of the optimum attitude control system for a particular missile or space vehicle requires special technical skills, facilities for conducting the necessary test program, and knowledge solidly based on related experience. All these are available "in quantity" at Vickers.

Actual experience dates back to hot gas servo studies initiated in 1955 and now covers the additional areas of hydrogen peroxide-powered reaction control, hypergolic bipropellants and secondary injection systems using either liquid (freon), or hot gas bled from engine combustion chambers.

The facilities and skills responsible for these developments in attitude controls are available to you as a vital aid in solving the problems of space-flight orientation. For more details, write for Bulletin A-5264, and/or call the Vickers' Application Engineer in your area. He is a thoroughly experienced practitioner in the "Programed Power"* field.



Nozzle designed for hypergolic bipropellant shown under test, flame temperature 5800°R. Exhaust flame is characterized by well defined series of shock diamonds.

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*PROGRAMED POWER IN:

POWER TRANSMISSION
ENERGY CONVERSION
FLUID TRANSFER

Space vehicle simulator used in development of attitude control systems weighs 2 tons, yet can be set in motion with a finger touch. Entire unit is supported on a 3-inch steel ball that floats on a hydrostatic bearing and is free to move in three planes: pitch, yaw and roll.

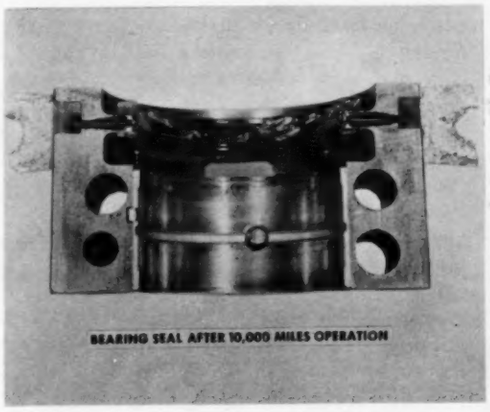
9781

Integral Cross Seals

Lars G. Soderholm, Midwest Editor

Projecting cross seals on a half-seal section provide a liquid-tight union between the parting faces of the seal support members. The cross seal portion is seated in a groove in the lower support which serves to retain the cross seal in the proper position.

There are many cases where complete sealing is desirable, but where a conventional ring-type seal cannot be slipped over the shaft. An engine



BEARING SEAL AFTER 10,000 MILES OPERATION

crankshaft is one example. The use of half seals offers a solution, but the weakness of half-seals has been at the split where additional seal components were needed.

In the new one-piece half-seal, molded projections extend radially from the end of the semi-circular half-seal section. These projections fit into a groove in either the lower or upper support member. Both half-seals are retained by a ring in the support members.

The cross-seal projections do not fill the groove entirely when they are placed in position, but project slightly above the face of the receiving support member. When the top surface is placed in position and assembled, the cross-seal projections are compressed and flow downward and outward in their grooved seats. This prevents loss of fluid from the area between the seal halves and the parting faces of support members.

The integral half-seals and cross seals were developed by Brummer Seal Div., Borg-Warner Corp., Chicago Heights, Ill.

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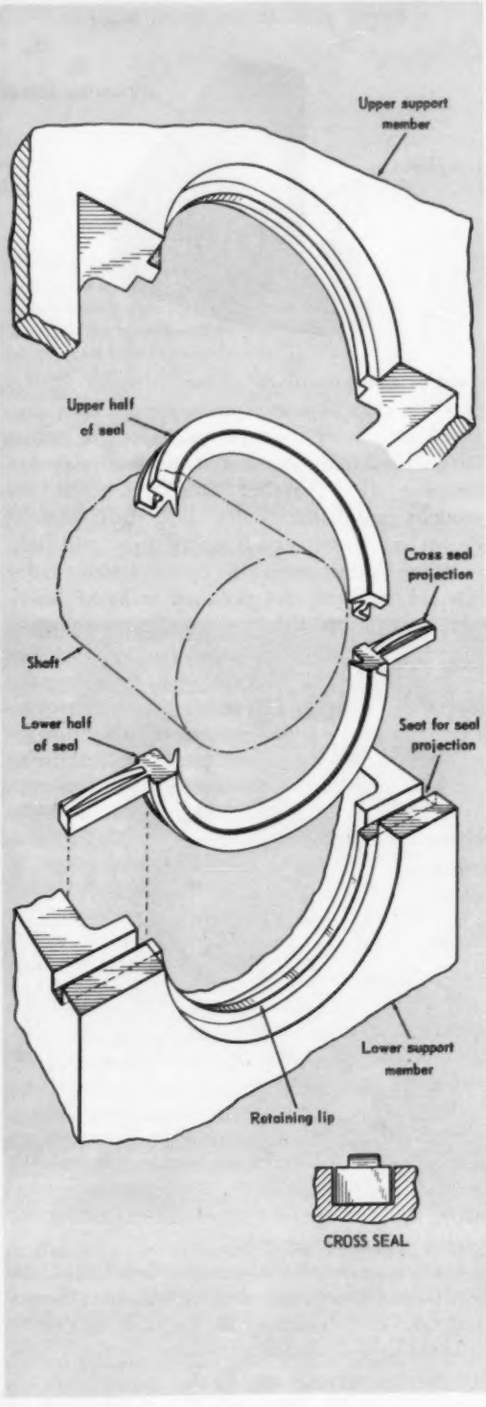
Tighten Half-Seal Sections



Anaconda Strip-copper coils cut size and weight

Strip-copper coils cut the size and weight of electrical equipment ranging from watt-hour meters using relatively small coils to pole-mounted distribution transformers rated up to 500 Kva. In many instances operating characteristics can be improved as well.

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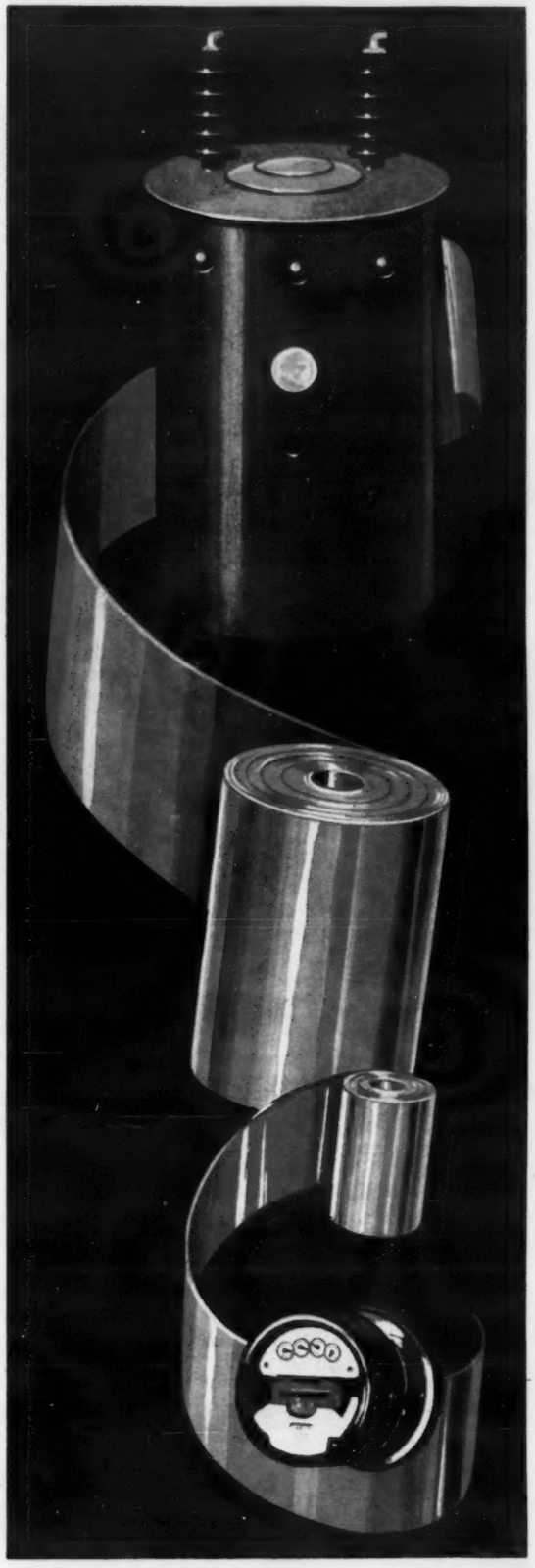
AMERICAN BRASS COMPANY



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FLO-BALL

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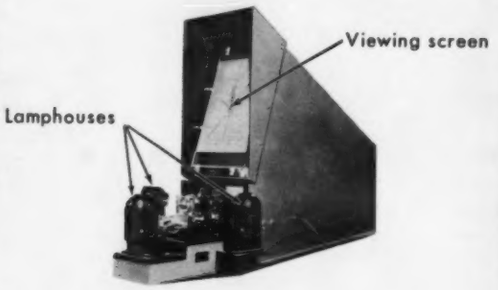
Optical Projection

Ronald W. E. Martin, British Editor



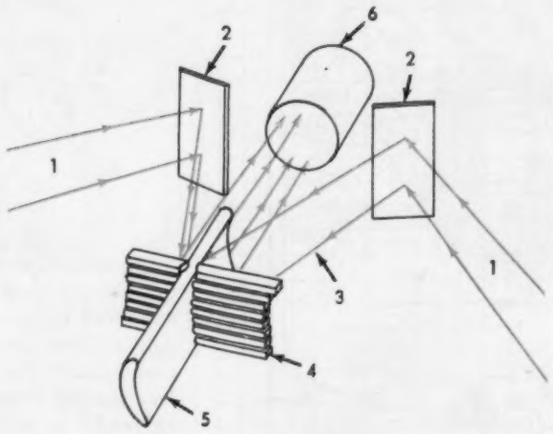
Tips of two groups of probes, brought against opposite sides of a workpiece, are optically projected to give an enlarged and complete profile image. Used to inspect turbine blades, the probes comprise flat, parallel laminae, which are brought against the blades along their contour. Probes are illuminated from the front and light reflected by them enters the optical system. Probe tips are radiused and polished to make point-contact with the blade surfaces. They are mounted in blocks formed by building up magnetic support plates interleaved with brass spacing pieces to form slots in which the probes slide. Use of magnetic plates maintains the probes in a constant plane, which is set to coincide with the object plane of the projector lens.

Each stack of probes is mounted on a carriage which slides transversely across the projector on linear-type bearings to reduce frictional loading. Both carriages are advanced or retracted by a control lever operated through a flexible cable with a 180-deg bend; the outer cable is fixed to one carriage, the inner cable to the other.

Flexing the cable provides a differential movement so that should one carriage, with its probes, contact the blade before the other, it remains stationary until the probes of the second carriage make contact. This arrangement equalizes pressure exerted by the probes on the blade. When the carriages are retracted, outer ends of the probes meet return blocks. These stop the probes while the carriages continue, thus resetting the probes for next operation.

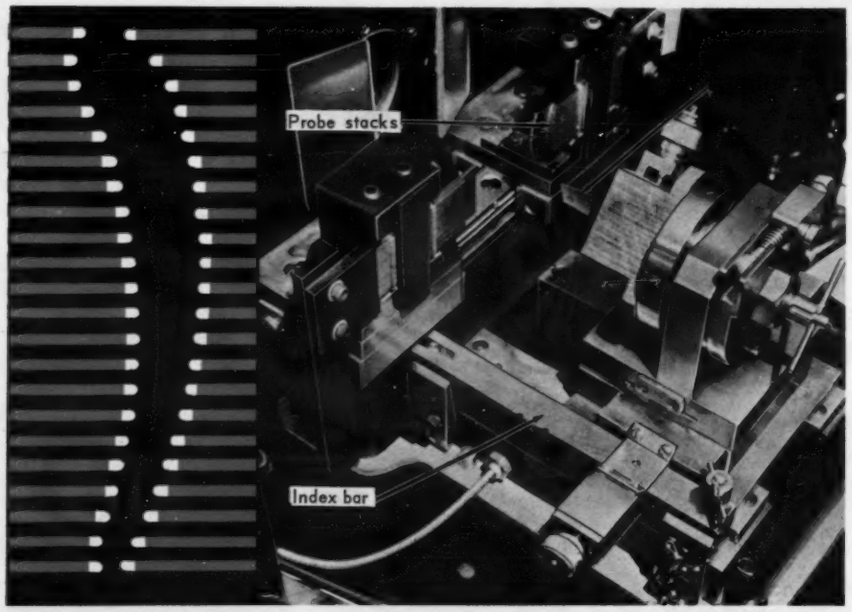
Known as the Shadowmaster Model 2412, the instrument is manufactured by Watson, Manasty and Co., Ltd., Teddington, England. It can be adapted to a variety of work where accurate profile measurement is required.

# of Probe Tips Checks Turbine-Blade Profile

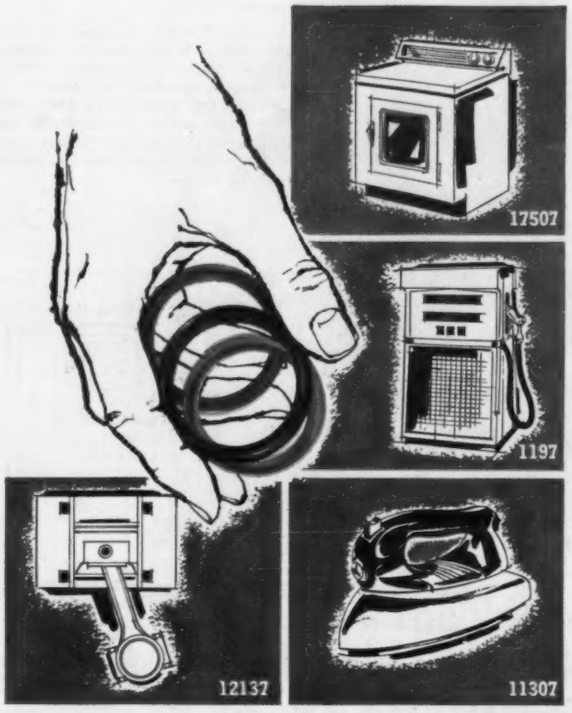


1 Light source
2 Universally mounted mirror
3 Light path
4 Inspection probes
5 Workpiece
6 Projector lens

PROBES are advanced by movement of control lever until they make contact with each side of blade. In this position they conform to convex and concave profiles of blade. Probe tips are illuminated from two episcopic lamphouses, one on each side of platform. Light from each lamphouse is reflected on to probe-tips by universally mounted mirror. Illuminated images of probe tips are projected on to viewing screen at magnification of 20X.



BLADE SECTION on viewing screen is enlargement of profile in form of points closely spaced around actual blade. Work platform carries workholding fixture and both stacks of probes. Stop-plate on concave side of blade is curved to preform probes to convex profile. This insures that first probes to meet blade on each side will be approximately opposite to each other. Any tendency to bend or twist blade by unequal pressure thus is avoided. Notched index bar allows blade to be set at predetermined stations for inspection of profile at different points along blade.



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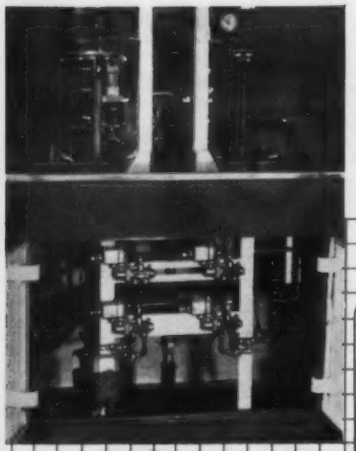
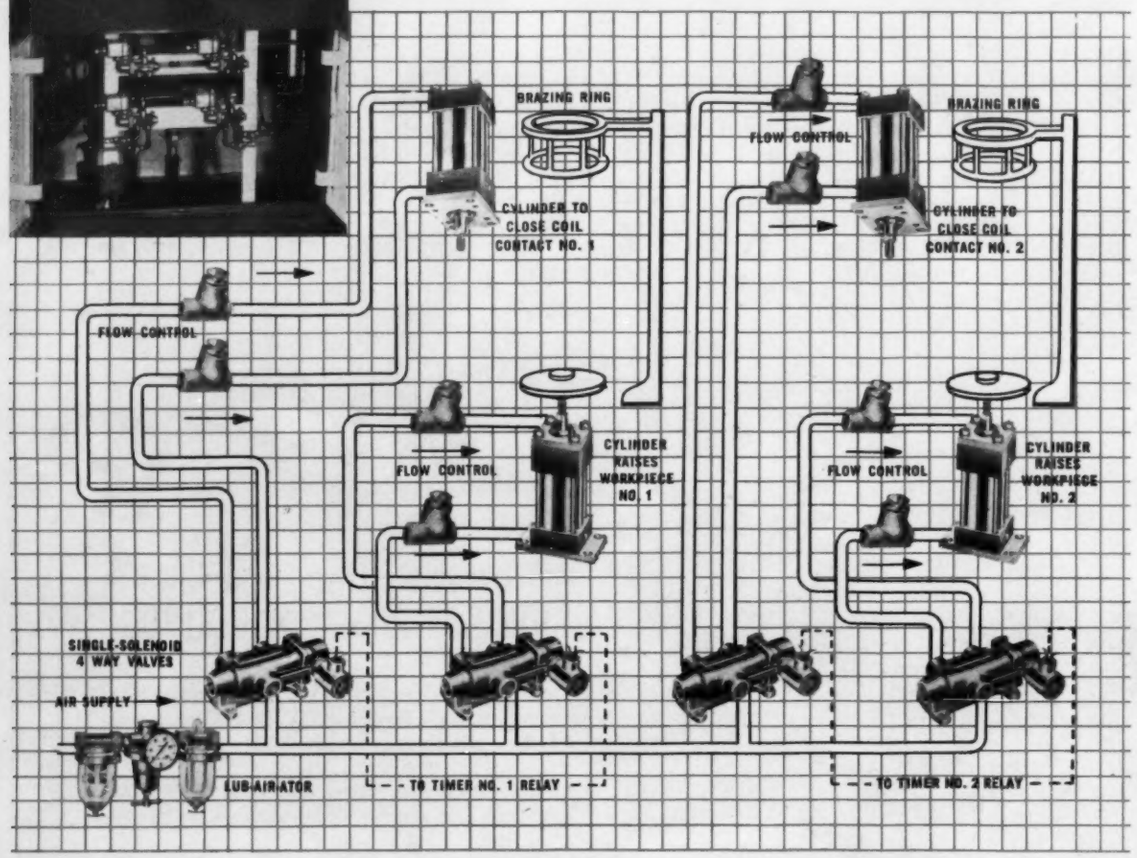


General Electric Company's Apparatus Service Shop in Detroit, Mich., uses Schrader air circuits to actuate and control this brazing machine. It enables one man to braze 120 planet carrier gear assemblies for automotive transmissions in one hour. Double-acting cylinders, actuated by solenoid valves, lift the assembly into position within the coil for brazing the shaft to the gear, and lower it for water quench. JIC cylinders control the induction heating coil contacts. According to Frank A. Ross, the designer, Schrader's Flow Control Valves close contacts so gently that they perform 750,000 cycles before needing replacement. In addition, air works successfully in a strong magnetic field, and the circuits can be simple.


BRAZING RING
CYLINDER TO CLOSE COIL CONTACT NO. 1
FLOW CONTROL
BRAZING RING
FLOW CONTROL
CYLINDER TO CLOSE COIL CONTACT NO. 2
FLOW CONTROL
CYLINDER RAISES WORKPIECE NO. 1
FLOW CONTROL
CYLINDER RAISES WORKPIECE NO. 2
SINGLE-SOLENOID 4 WAY VALVES
AIR SUPPLY
LUB-AIR-ATOR
- - TO TIMER NO. 1 RELAY - -
- - TO TIMER NO. 2 RELAY - -

TOUGH BRAZING JOB BECOMES A BREEZE... WITH SCHRADER AIR CIRCUITRY

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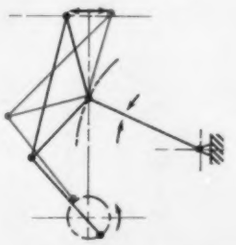
Novel Link System

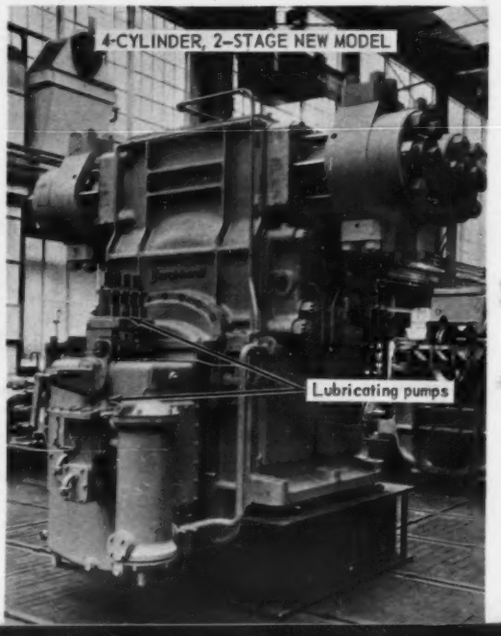
Curtis W. Lowe, Mgr., European Division



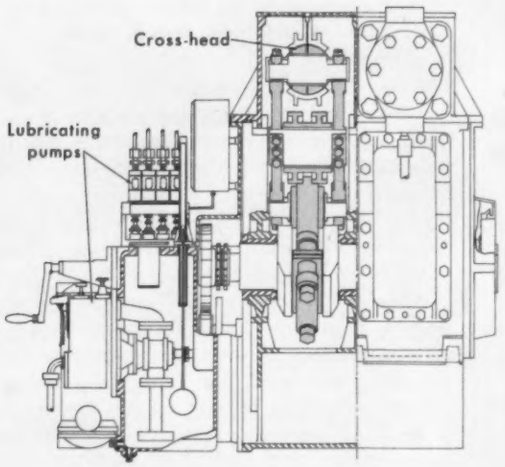
An intermediate drive link transmits power from the oblique connecting rod to the horizontal cross-head by pivoting on a swing arm. This design reduces floor-space requirements for the compressor, while also cutting its height. Important moving elements are lighter and all parts are readily accessible for maintenance.

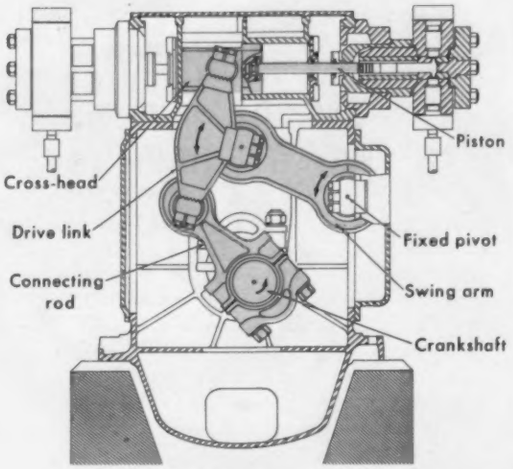
Ends of the drive link are attached to the connecting rod head and cross-head, respectively. The link is pivoted at its center on an arm which itself swings around a support fixed on the compressor housing. Excursion and angular acceleration of arm and link are relatively small. Forces on the driving parts are further reduced by making the cross-head double-acting. With pistons at each end working alternately in the same stage, the drive is loaded only by the difference between piston forces.

This compressor is designed and manufactured by Maschinenfabrik Burckhardt, Basel, Switzerland.



Converts Rotary to Linear Motion in High-Pressure Compressor





COMPRESSOR is driven at 250 rpm by 1100-hp electric motor bolted directly to short crankshaft. Motor's rotor acts as flywheel for compressor. Drive link actually comprises two identical halves, separated by connecting rod, swing-arm and cross-head. Intake pressure to first bank is 251 ata and final output may be as high as 2500 ata at production rate of 5000 kg/hour. Stroke is 200 mm. High pressures in cylinders require shrink-fit design. Liner is lubricated with special-formula oils by individual piston pumps for each cylinder. This oil is expended.

THE AMPLEXOLOGIST

puts a customer in clover

This engine fan-pulley hub was formerly a solid circular casting. The manufacturer had to machine the face, bore the ID, drill and tap four holes. The Amplexologist designed the present cloverleaf shape to reduce weight and material cost. Now produced by powder metallurgy, the hub requires no machining—except tapping the holes. Total savings 33%. Sound interesting? Call the Amplexologist.

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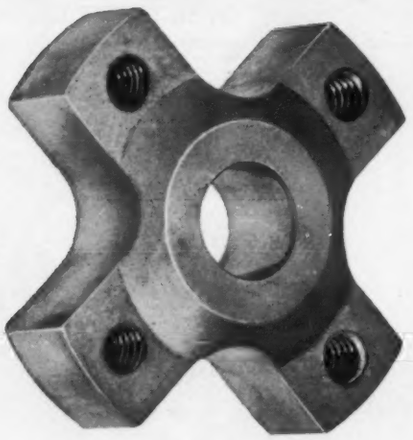

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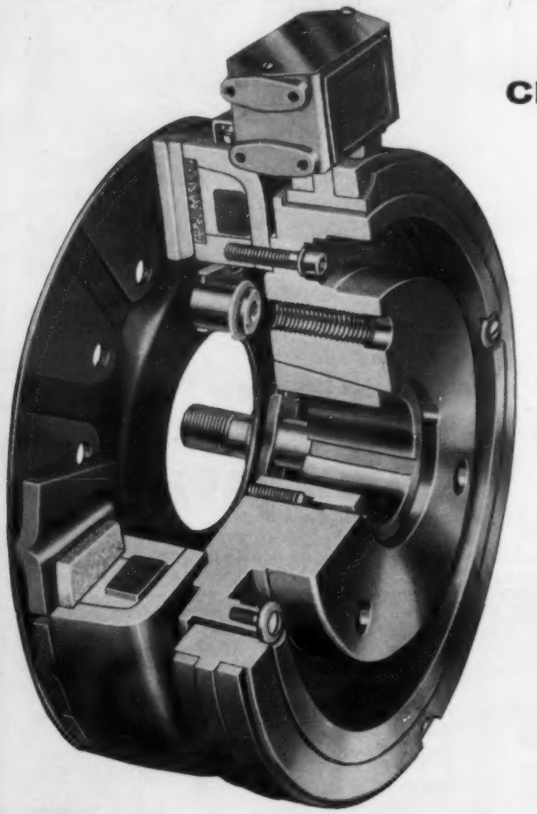

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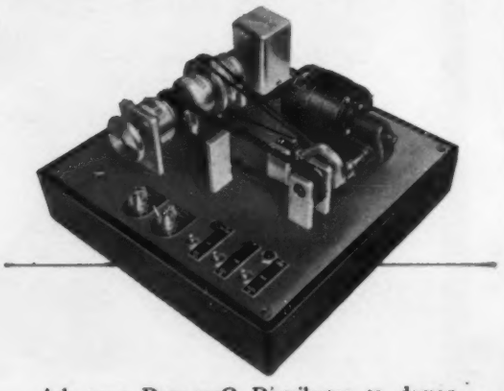
HP @ 1800 R.P.M. *(Typical Application)*

MODEL	HP	MODEL	HP
302	1/20	308	7½
303	⅓	310	10
304	1	312	20
305	2	315	25

Dyna-torQ Distributors in many principal cities carry Dyna-torQ Clutches and Brakes in stock for immediate delivery.



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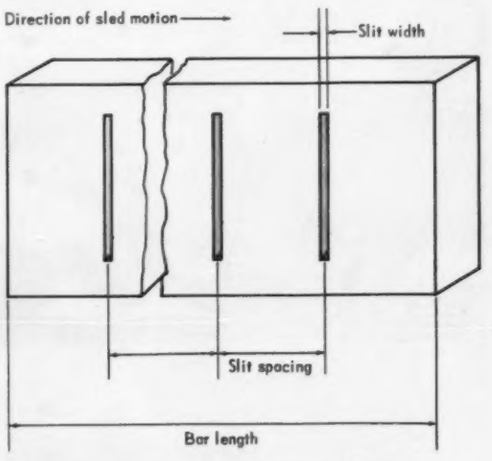
Space-Time System Determines

Lars G. Soderholm, Midwest Editor

The problem of measuring rocket-sled velocities to an accuracy of 0.1 fps at speeds up to 2500 fps resulted in a research program in which a space-time system of velocity measurement was proposed. In this system a measured length on the sled is timed as it passes fixed points along the track. Velocity is obtained by the differentiation of this space-time data.

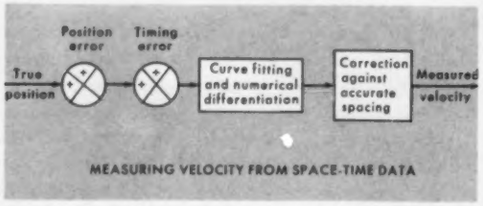
When rocket-sled velocities were low and track lengths relatively short, accurately measured monitor stations were set up to indicate when the sled passed particular stations. As speeds increased and tracks became longer, the problem of accurately surveying the stations became more complicated.

In the proposed space-time system, a bar with a series of equally spaced slits is located on the sled and oriented in the direction of sled movement. A photo detector is placed behind each slit in the bar. Collimated light sources are located along the track. Distances between lights are slightly greater than those between outermost slits of the bar. These light sources do not have to be accurately located. As the sled passes, each light pulse, representing a slit in the bar, is detected by equipment on the sled and then telemetered to a central station where the time between pulses is determined and recorded. The data then consist of known spacings between slits and measured time intervals between pulses. Velocity can be computed by numerical differentiation.



PROPOSED BAR FOR MOUNTING ON ROCKET SLED

Rocket-Sled Velocities



MEASURING VELOCITY FROM SPACE-TIME DATA

Velocity found using the space-time formula is inherently average velocity as seen from the formula:

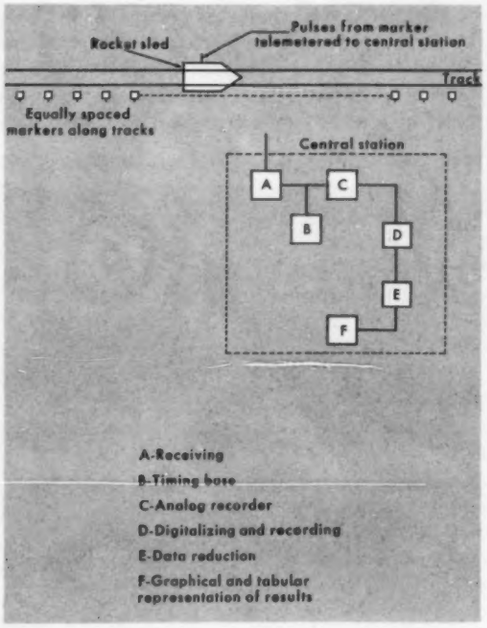
$$V_{av} = \frac{\Delta s}{\Delta t}$$

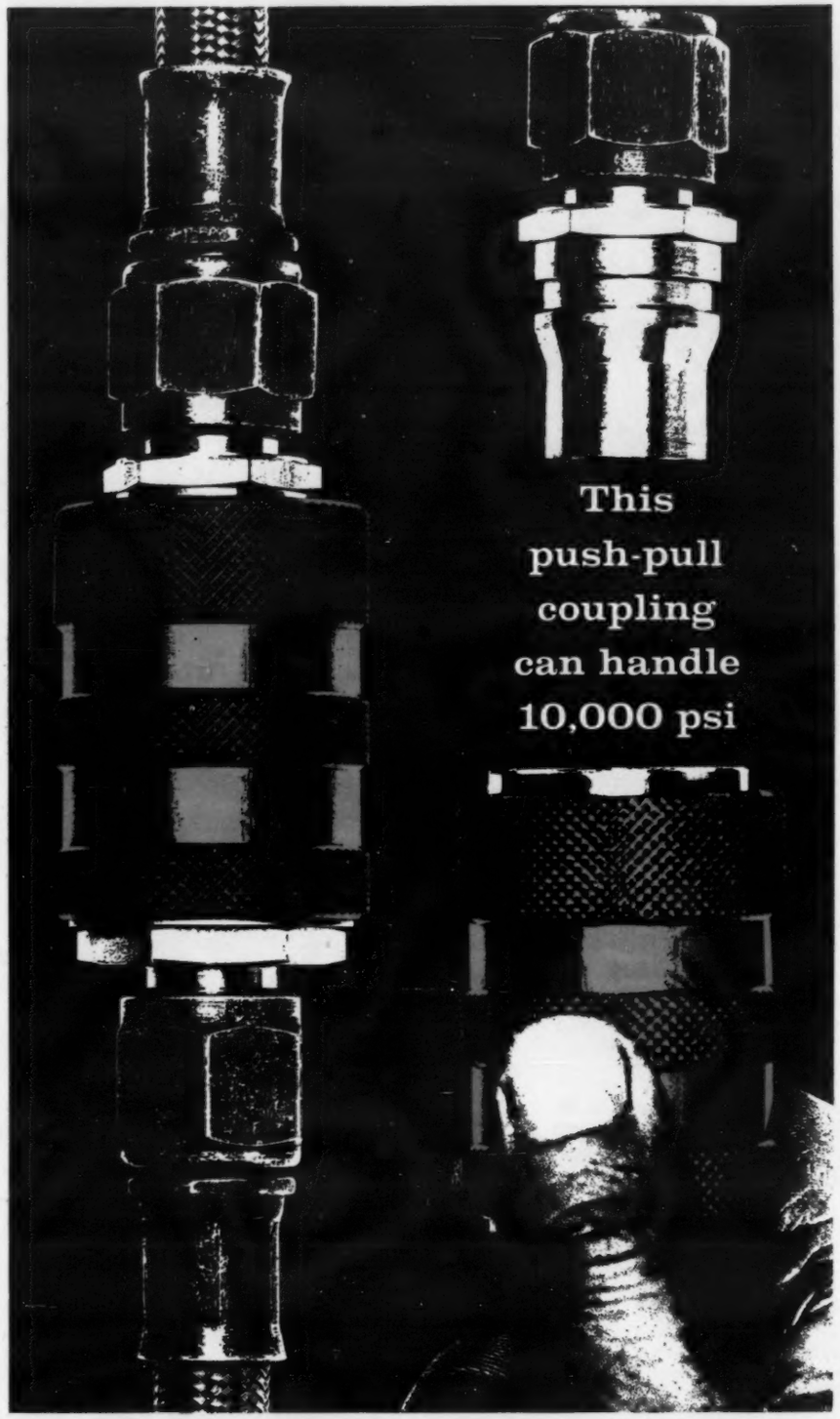
Instantaneous velocity is the limiting case:

$$V_{inst.} = \frac{dx}{dt} = \lim_{\Delta t \to o} \frac{\Delta x}{\Delta t}$$

Through calculation it was found that by using position detectors (photocells) mounted at 0.25-ft intervals on the sled with an assumed 0.001 accuracy and by using a timing frequency of 5 mc per sec with an allowable 0.7-ms error, all system requirements for accuracy can be met between sled velocities of 200 and 2500 fps.

This study was performed at the Midwest Research Institute, Kansas City, Mo., for the Holloman Air Development Center.





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And both coupling halves exceed all requirements of MIL C-25427 for fluid loss, pressure loss, air inclusion, and physical shock. Temperature range is −200°F to +450°F.

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Unlike conventional air cylinders which require separate remote directional and speed control valves and dual piping, the Bellows Air Motor is a complete power unit with directional valve and dual speed control valves built-in as an integral part of the unit. Only one air connection, which can be made with flexible hose, is required.

Integral valve and cylinder construction means quick response, more positive response, more precise control and more economical operation.

The Bellows Air Motor is made in five bore sizes: 1¼", 1¾", 2½", 3⅝", and 4½", and in any stroke length.

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DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

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Eccentric Whirling Toolholder

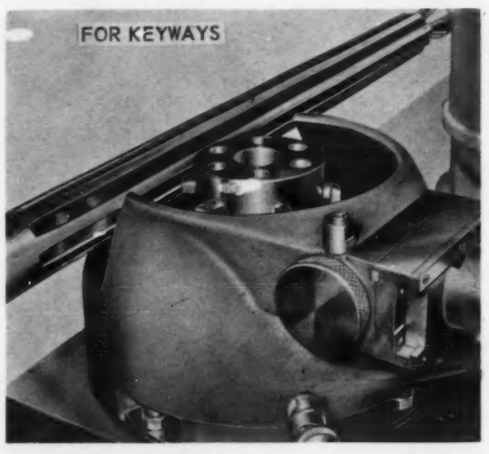
R. F. Stengel, German Editor

In a novel threadcutting setup, a ring-shaped toolholder whirls at high speed eccentrically around the slowly co-rotating workpiece. As tool tips are engaged only along part of their circular travel, torsional stresses in the workpiece are eliminated. Flywheel action of the heavy toolholder ring, driven by an independent motor, suppresses axial and radial vibrations.

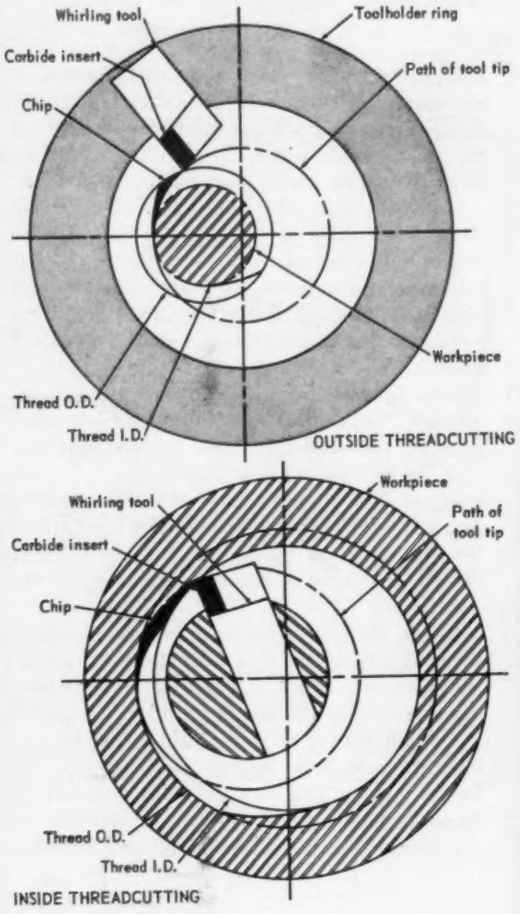
Cutting load is shared by four tools spaced at 90-deg intervals around the toolholder. Two roughing tools are opposite each other and cut the entire depth of the thread; the remaining two stations hold a finishing tool and a chamfering tool. Thread material is removed in four flat, easy-flowing chips, instead of the U-shaped chip produced by conventional tooling.

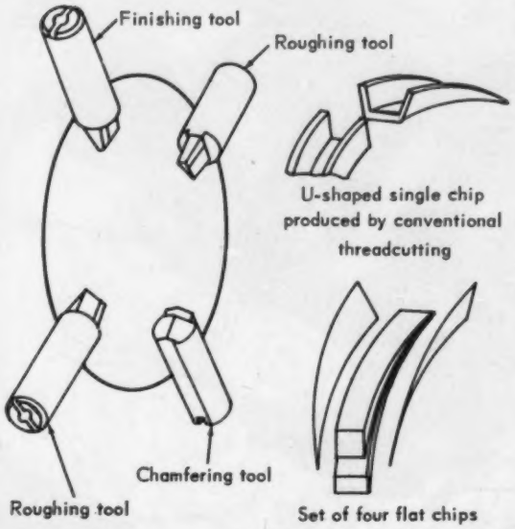
The toolholder ring rotates at least 100 times faster than the workpiece. As tool tips cut only short chips and spin through air during 75 to 80 percent of each revolution, the effective cooling prolongs tool life. Most of the heat generated in cutting is removed in the chip. The remainder has had only a short time to penetrate into the metal; the heated zone again is removed in the next chip. The workpiece remains almost cold and is free from thermal warping. Multiple tool action reduces machining time to a small fraction of conventional time requirements.

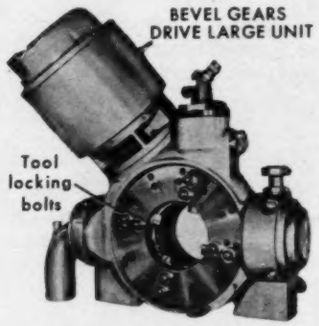
The toolholder ring runs on pre-loaded ball bearings in a cast-iron housing. Power is transmitted from a pole-reversing motor through V-belts or spiral bevel gears. The thread helix angle is set by a worm and wormwheel segment which



Cuts Threads in Co-Rotating Workpiece




Finishing tool
Roughing tool
U-shaped single chip produced by conventional threadcutting
Chamfering tool
Roughing tool
Set of four flat chips produced by whirling tools

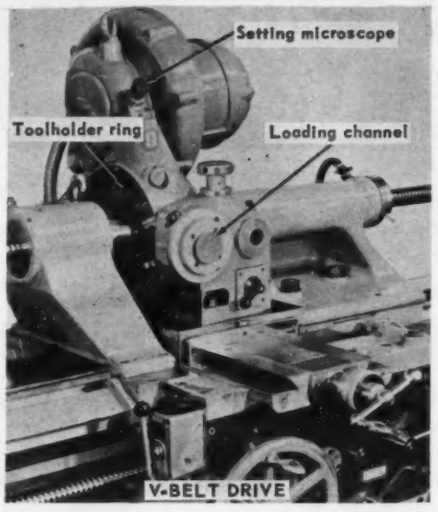


inclines the entire unit. Longitudinal feed is provided by the lathe motor via a leadscrew.

Tools are inserted through the loading channel, positioned by a mandrel under the interchangeable reticule of a 10x setting microscope and held in place by two fine-thread locking bolts. Optical equipment is protected from chips by a small deflection shield. A suction hood keeps chips from damaging the workpiece surface.

Basic design handles external threads up to 4 inches in dia. A complementary version for machining inside threads uses a tool bar instead of a ring. For cutting trapezoid or parallel keyways, a third version has a horizontal whirling ring which spins alongside the workpiece on a 140-mm-dia tool tip path.

The whirling unit is manufactured by H. Burgsmueller & Soehne GmbH, Kreiensen, Germany.



IT PAYS TO KNOW **Perma-Nuts®**

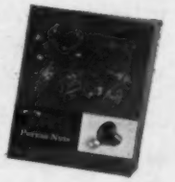
EMENEE Got a Much

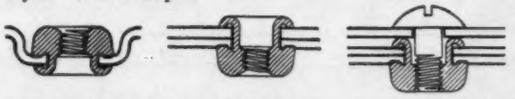
SIMPLER PLASTIC-TO-METAL ATTACHMENT

"Knowing about the TRS Perma-Nuts when our electric chord organs were designed enabled us to make an almost 'impossible' assembly . . . easily, at low cost and at a high production rate," states Emenee Industries, Inc., New York, world's largest manufacturer of musical toys. "The problem was to attach a reed housing, made of high impact styrene, to a steel turn plate with a threaded fastener. Tapped threads in the styrene would have been subject to stripping. Design of the parts allowed inadequate clearance for a nut, and handling a nut in the semi-blind location would be very difficult, if not impossible."

The ideal solution was found in Perma-Nuts, automatically fed and set (just like rivets in metal) by standard TRS riveting machines, air-powered to afford controlled "cushioned" action which clinches Perma-Nut to the styrene without breakage.

Whether *your* attachments are made to metal or plastic, it will pay well to see if Perma-Nuts will do the job. Ample threads in the head for holding power. Sharp serrations under head act as a lockwasher. Head size is same as hex nut of same size. Nine thread sizes, #3-48 to ¼-28 available in steel, brass, aluminum. *SEND for Catalog* showing many ways to use these versatile helpers. Or look in "Yellow Pages" for nearby TRS man to give you facts or help.





FLUSH MOUNTED NUT PLATE NUT & RIVET NUT & RIVET & SPACER

TRS® TUBULAR RIVET & STUD COMPANY
QUINCY 70, MASSACHUSETTS

Circle 38 on Reader-Service Card for more information

new from Warner Electric

easier mounting, greater torque-for-size Electric Clutch

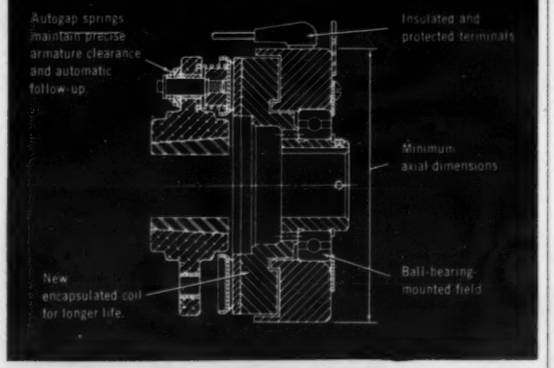
New Warner SF 500 clutch
Static torque rating—50 lb-ft

This new rugged and reliable Warner SF 500 electric clutch combines minimum size with maximum torque—up to 50 lb-ft static. It offers simplified mounting (no collector rings or brushholder) of the ball-bearing-mounted stationary field.

The new encapsulated coil delivers peak reliability, longer life under the severest operating conditions. Minimum axial dimension permits installation of the new SF 500 in smaller space than ever before possible—yet it replaces existing units without reworking or machining.

Improve *your* machine control economically, simply—with the new Warner SF 500 stationary-field clutch. It eliminates complex hydraulic, air, or mechanical linkages—gives you the simplest, most reliable control on the market today. Warner stationary-field electric clutches are now available in torque ratings from 1.5 lb-in. to 1350 lb-ft. Write today for full details.

Check the advanced design features of this new SF 500 clutch


Autogap springs maintain precise armature clearance and automatic follow-up
Insulated and protected terminals
Minimum axial dimensions
New encapsulated coil for longer life
Ball-bearing mounted field

----WARNER ELECTRIC----

Warner Electric Brake & Clutch Co., Dept. DN-10 Beloit, Wisconsin

I'm interested in the new SF 500 clutch. ☐ Send me full specifications. ☐ Have a salesman call.
☐ Send data on complete Warner line of electric brakes and clutches.

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Address_____

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Stocked by Authorized Distributors in Principal Cities Throughout the World

Circle 39 on Reader-Service Card for more information

Double-Walled Container

R. F. Stengel, German Editor

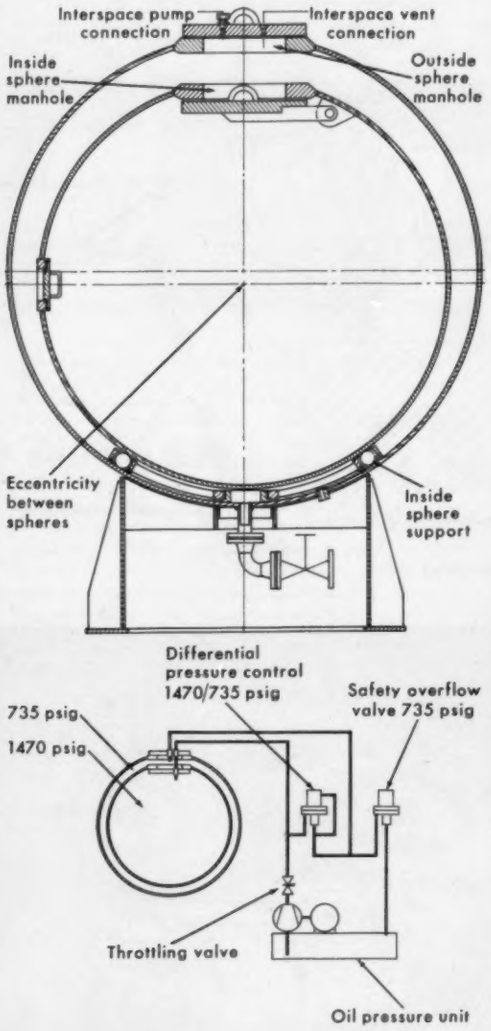
A high-pressure gas storage container consists of two nearly concentric spherical vessels. Interspace between the spheres is pressurized to one-half of the gas pressure within the storage container, dividing stresses evenly between the two shells.

Wall stresses increase directly with sphere size. Since present state of the art limits the thickness of safe welds, there is at a given storage pressure a definite maximum diameter for single-wall containers. Double-wall design therefore doubles the amount of gas that can be stored in a given volume.

Both spheres are welded from 20-mm high-strength, fine-grained carbon steel. Inside diameters are 1960 and 2260 mm. At 1470 psig pressure, inner shell holds approximately 14,000 standard cu ft of gas. Center of inside sphere is 60.5 mm below center of outside sphere. Contact between shells is limited to bearing balls arranged in a circle at about 30 deg from the bottom point.

Inside shell is assembled from four sheets, covering a belt up to 45 deg from horizontal, and two caps. Access is provided by a 400-mm-dia manhole in the top cap and a 150-mm-dia inspection port. The outside sphere is being assembled from four "orange peel" sections each for its top and bottom halves. Inside seams can be welded and X-rayed through the manhole and the port of the inner shell which turns or tilts on

Increases Gas-Storage Capacity



bearing balls.

For filling, inside sphere pressure is first raised to 735 psig. Automatic controls then initiate pressurizing of the interspace, keeping 735 psig differential pressure between interspace and inner shell, until container has reached maximum pressure of 1470 psig. Pressure levels are limited by safety valves and through shutdown valves controlled by contact manometers.

The double-wall, high-pressure gas container is a development of Maschinenfabrik Augsburg-Nuernberg, Gustavsburg Works, Germany.

PROVEN PERFORMANCE

The Alkon Series A 4-way valve line sets new high standards of service and reliability. Carbide-hard working and sealing surfaces end troublesome seal swelling and scoring, insuring long life with low maintenance.

NEW Even greater circuit flexibility is built into the new Alkon pilot-operated solenoid valve — and a complete ⅜" line has been added to the 50-million-cycle reliability of the proven ¼" line. All actuators are available — direct solenoid, pilot solenoid, pilot, bleeder, hand, foot, palm button. Now ⅜" as well as ¼" sub-plate mounting is standard.

LOWEST PRICES and high value are the hallmarks of all Alkon products—valves, cylinders and drill units. Check these prices!

NEW pilot operated single solenoid valve . . . $29.75

NEW pilot operated double solenoid valve . . . $44.75

Write today for Alkon's new 24-page catalog!

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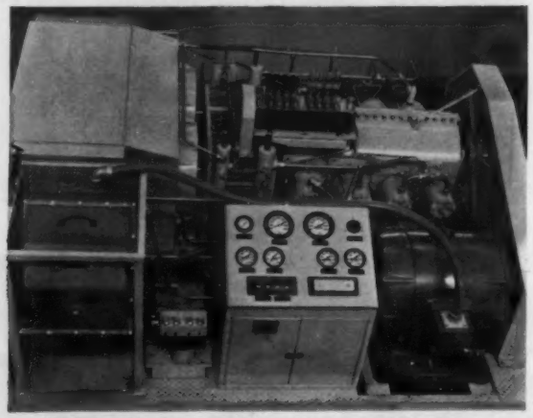
When You Need

HIGH PRESSURE
HIGH CAPACITY, HIGH PURITY

AIR, HELIUM NITROGEN

FOR COMPONENTS TESTING OR PRODUCTION



MODEL DPB-CCS Four-stage, 8-cylinder compressor. System includes full dehydration and oil removal, filter and complete control panel. Backed by Cardair's 20 years of high pressure gas experience. The only ICBM type compressor qualified by 2500 hour life test.

CCC CARDAIR CENTRAL COMPRESSION SYSTEMS

Guarantee Delivery

- up to 12,000 psi continuous
- with less than 1 ppm oil content
- 150 SCFM @ 128 psig intake • dewpoint −100°F.

Developed and qualified as GSE equipment for ICBM program—now available from stock or programmed production!

Most recent broad purpose Central Compression System in the Cardair line, the Model DPB-CCS is a semi-portable, skid mounted unit, ready to install on location in less than a day. Only electrical and high and low pressure connections are needed.

In addition to air, helium and nitrogen, it can be easily adapted to other gases including hydrocarbons and hydrogen. Pressure range is from 3500 to 12,000 psi in continuous service and to 15,000 psi intermittently. Complete dehydration and oil removal equipment are included.

For either testing or production, it may also be used as a central high pressure source for diverse locations, with Cardair supplying the complete system.

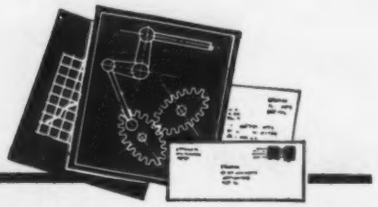
Maintenance is simple and minimal, with nationwide Cardair service facilities. Installation is easy—no heavy concrete base is required.

Write today for illustration sheet and technical data—or send us information on your particular high pressure supply needs.

CARDAIR
DIVISION OF MARMON-HERRINGTON COMPANY, INC.
Dept. 18, Box 147—Lebanon, Indiana

Circle 41 on Reader-Service Card for more information

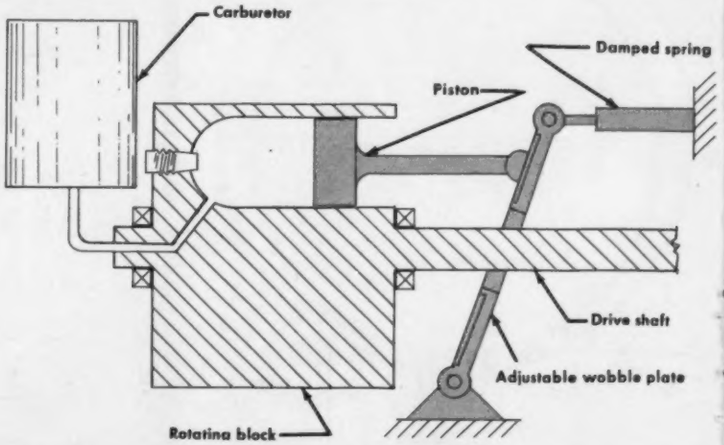
IDEA MART
DESIGN NEWS



AVAILABLE

Adjustable-Stroke Internal-Combustion Engine

Piston rods bear against a stationary wobble plate of adjustable angle in this internal-combustion engine. The entire cylinder block rotates. A possible adjusting means could utilize a damped spring. This spring should be designed to deflect in proportion to load applied. A simple clutch and accelerator should be sufficient for controlling the engine through a wide range of load conditions. Timed operations (cam-operated valves, distributor switching, etc.) may be obtained directly from the block rotation by placing actuating mechanisms around the edge. Write IM 531, Idea Mart, DESIGN NEWS, 3375 S. Bannock, Englewood, Colo.



CONTROL

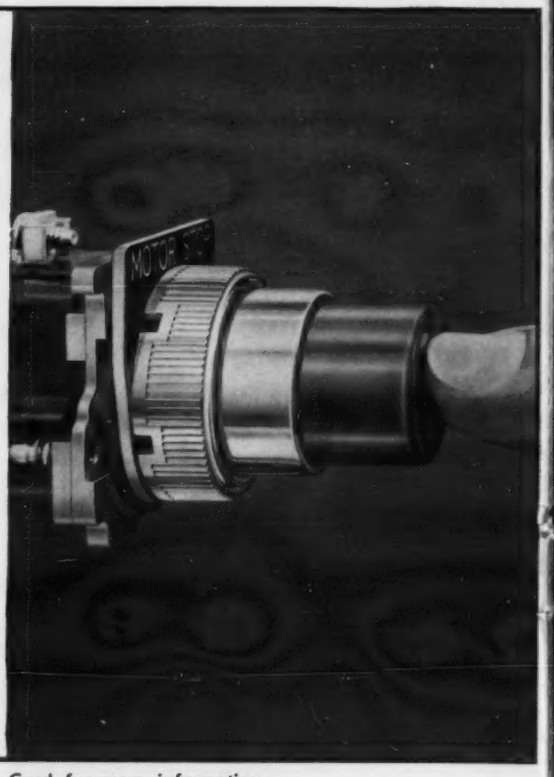
New! Versatile Cutler-Hammer oiltight pushbuttons let you make any station you want

The new interchangeability built into these operators lets you create the station you want from a complete selection of Cutler-Hammer pushbuttons. Get them in one hole or base mounting, 6 bright colors. Thirty different circuit arrangements can be made in hundreds of varieties of stations in standard arrangements of up to 25 elements. Get up to 8 circuits on one pushbutton. They take 40% less back-panel space than next smallest unit so you get more control in less space Get facts in PUB. LO-104-U272.

WHAT'S NEW? ASK...

CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C. A. • Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S.A.

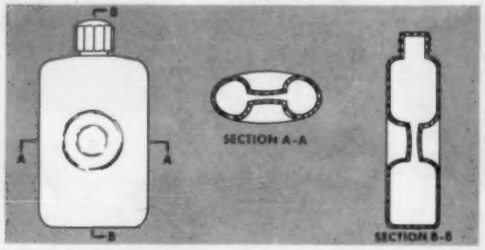


Circle 42 on Reader-Service Card for more information

AVAILABLE

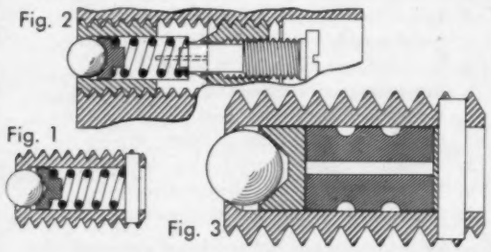
Measuring-Dispensing Container

This patented one-piece flexible container will measure and dispense portions of its contents with accuracy adequate for use with lotions, creams, liquid detergents and similar fluids. The device may be fabricated from a flexible plastic such as polyethylene which may be produced commercially by injection and compression molding. The patent is available for sale or license. Write IM 526, Idea Mart, DESIGN NEWS, 3375 S. Bannock, Englewood, Colo.



Ball Plungers

Purpose of these designs is to provide a simple ball plunger that may be constructed and assembled easily. In Fig. 1, the body may be machined to restrict the ball from passing through. The unit is assembled from the larger open end with a ball, a spring-guide, a spring and a soft metal or plastic pin. Use of washers under the pin will permit adjustment of ball pressure. In Fig. 2, four milled cross slots replace the pin. When these are spread slightly to cause locking of portion B by use of a follow-up nut, each locks the other. The screw provides adjustment of ball pressure. A similar design is shown in Fig. 3. A rubber spring with circumferential grooves is used with a washer and pin. Write IM 530, Idea Mart, DESIGN NEWS, 3375 S. Bannock, Englewood, Colo.



AVAILABLE

Printed Circuits

I would like to contact anyone who might have an application for printed circuits formed on the inside and outside of tubes and spheres (hemispheres joined to form spheres). Cylinders permit the formation of coils and capacitors as part of the printed circuit. A number of concentric tubes or spheres would provide a high-density assembly. Electronic assemblies so constructed could have open centers for sensing optics inside the cylindrical shape of a small missile, television camera, electron microscope, etc. Write IM 529, Idea Mart, DESIGN NEWS, 3375 S. Bannock, Englewood, Colo.

Tough, durable Mylar® cuts costs... improves product performance

For example, "Mylar"* polyester film gives many products extra resistance to chemicals and moisture . . . lengthens their life. Today, "Mylar", with its resistance to heat and cold, high tensile strength in thin gauges, is improving the performance of products as different as glazing film and tough, magnetic recording tape.

Can this unique plastic film and products made with it help you? For more information on "Mylar", write: Du Pont Co., Film Dept., Room #8, Wilmington 98, Del.

1. Motor size and weight are reduced with no decrease in horsepower when thin, light weight insulation of "Mylar" polyester film is used.

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*"Mylar" is Du Pont's registered trademark for its brand of polyester film.

Better Things for Better Living . . . through Chemistry

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MYLAR
POLYESTER FILM

Circle 43 on Reader-Service Card for more information

For Long Life,
Power
Economy...
Specify the
NEW
TYPE LF relay shown (cover removed) is 2-coil design which controls entire latching operation within relay. (Actual size).

CLARE LATCHING SUBMINIATURE crystal can RELAY

The new CLARE Type LF, magnetic latching subminiature relay offers designers simplified circuitry in small space by providing latching effect without transistors. Magnetic latching results in power economy.

The Type LF is available with either 2-coil or 1-coil configuration. The 2-coil relay allows complete control of the latching operation within the relay and provides an extremely compact operating unit. The 1-coil relay is somewhat more sensitive; it is adaptable to existing circuits where outside control is provided. The Type LF provides the same wide range of mounting arrangements and terminals as the CLARE Type F relay.

FOR NON-LATCHING OPERATION

CLARE *Type F*
SUBMINIATURE CRYSTAL CAN RELAY

The CLARE Type F relay is extremely fast and more than moderately sensitive. It is built to withstand temperature extremes, heavy shock and extreme vibration. Contacts, rated at 3 amperes, are excellent for low-level circuit operations. Send for Design Manual 203.

For coil and mounting data on CLARE Type LF relay send for CPC-12. Address: C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. In Canada: C. P. Clare Canada Ltd., 840 Caledonia Road, Toronto 19, Ontario. Cable address: CLARELAY.

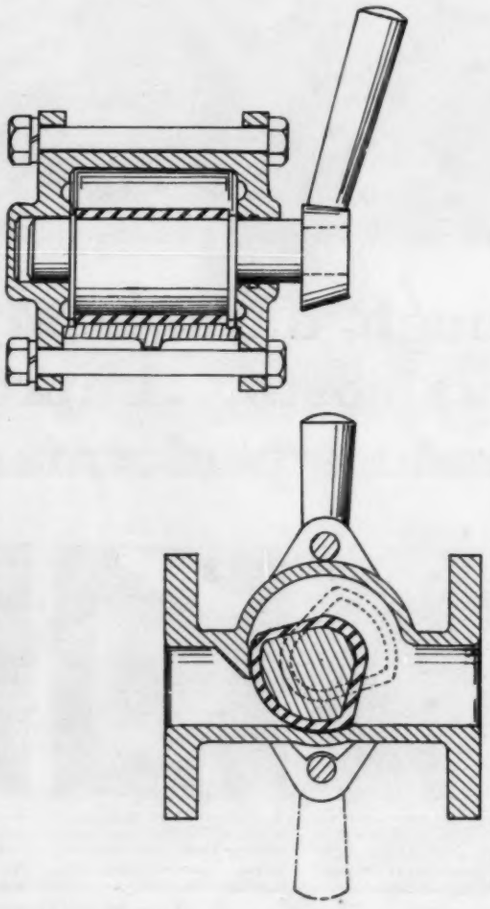
C. P. CLARE & CO.
Relays and related control components

Circle 44 on Reader-Service Card for more information

Flow-Control Valve

British Patent 863,847; Ian N. Merrill, Merrill Pumps, Ltd., Sheffield 11, Yorkshire, England.

A flexible, easily renewed tube, fitted with light frictional engagement around a rotor, forms the closure member in a simple flow-control valve. The rotor is shaped with a circular segment functioning as the operative portion. When the handle is turned to close the valve, the tube rotates with the rotor and contacts the two circular seats only during sealing engagement. The tube ceases to rotate when sealing is completed and, thereafter, slips on the rotor. Opening and closing moves the tube relative to the rotor, insuring that its whole surface is used in turn. Instead of a single tube, two concentric flexible tubes can be fitted. The inner tube is made from more resilient material than the outer.



Use variable-speed, explosion-proof

GAST AIR MOTORS

Need a compact, low-cost motor for original equipment or plant use applications? *Air may be your answer . . .* using one of these efficient Gast rotary-vane Air Motors. Look at the special advantages they offer you:

1. They're explosion-proof — no sparks, no danger!
2. Low initial cost compared to other motors.
3. Speed variable with simple valve control.
4. Can't burn out if overloaded or stalled.
5. Reversible rotation optional on some models.
6. Rotor vanes take up their own wear.
7. Quickly attached to plant air lines.
8. Amazingly light, compact for h.p. delivered.
9. Ball-bearing; almost service-free design.
10. Mechanically simple, neat in appearance.

Gast Air Motors are supplied as original equipment on pneumatic hoists, mixers for paint and chemicals, fans, blowers, fuel hose-reel rewinders, liquid pumps, spooling machines and a host of other products. Used in explosive atmospheres and in "hot" locations to 250° F.

Model No.	1AM	2AM	4AM	6AM	8AM	16AM
H.P. at 90 P.S.I., 2000 RPM	0.13	0.57	1.1	2.0	4.0	7.0
Weight, lbs.	1½	5½	8	17	25	65

For complete performance data, write for Air Motor Bulletins. Specify models that interest you.

THEY'LL DRIVE EQUIPMENT 4 WAYS:

AIR MOTORS • VACUUM PUMPS • COMPRESSORS

GAST MANUFACTURING CORP.
P.O. BOX 117-G, BENTON HARBOR, MICHIGAN

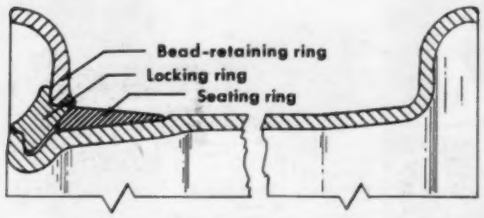
Circle 45 on Reader-Service Card for more information

Divided Wheel Rim

British Patent 859,178; Jaroslav Hrdlicka, 98 Lahovice, Zbrazlav, Czechoslovakia.

A detachable, wedge-section seating ring, a separate bead-retaining ring and a split locking ring simplify tire fitting and removal. The parts are assembled on a rim base having a tapered outer surface terminated by a walled groove.

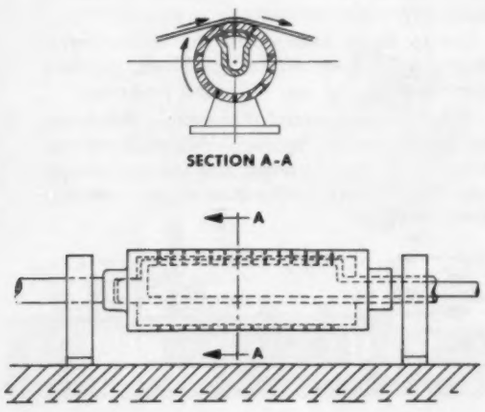
The locking ring has two opposite concave sides. One side seats on the rim base groove wall; the other locates the bead-retaining ring relative to the rim base when the tire is in position. The locking ring inner straight side locates against the wedge ring outer surface.

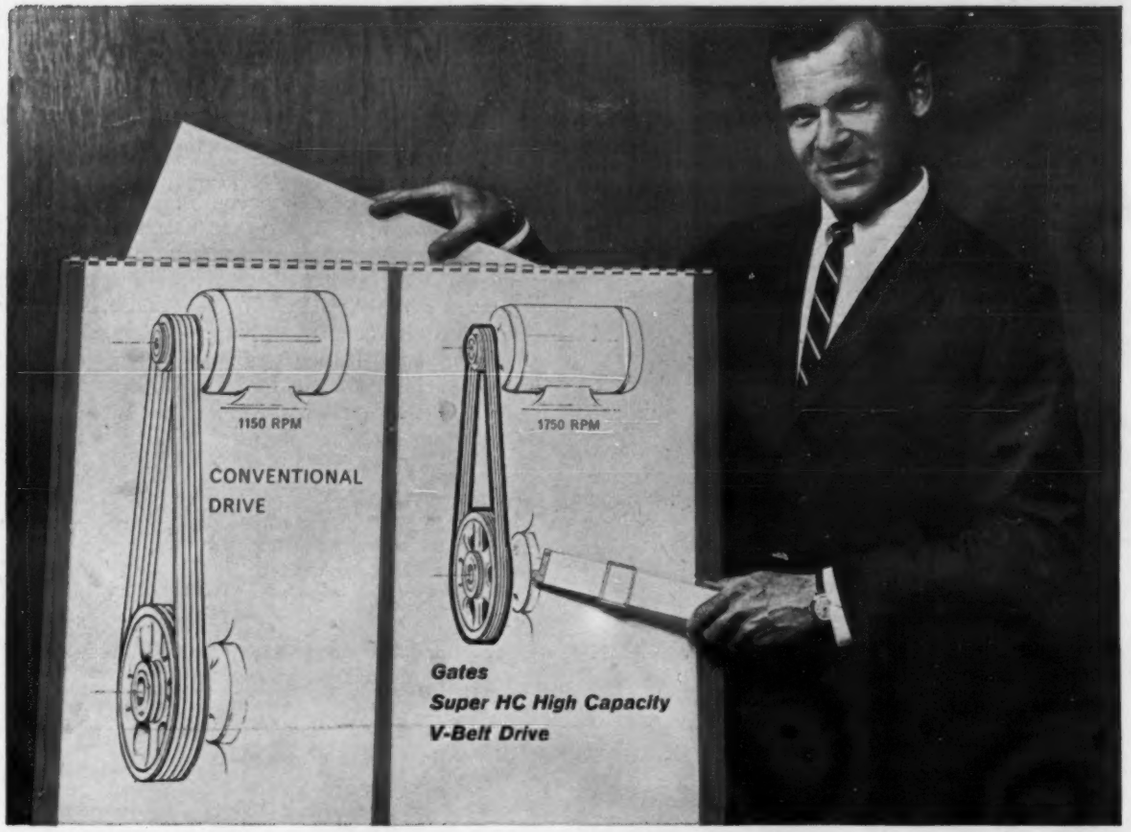


Linear Speed Measurement

British Patent 856,974; William Spence, British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2, England.

Linear speed of strip material is measured accurately for control purposes by leading the material over a perforated freely rotating roller which is subjected to an internal partial vacuum. Suction effected through the perforations prevents slip between the hollow roller and strip driving it. Reduced pressure at the contact region is produced by connecting a vacuum pump to a stationary trough mounted inside the roller. Slip elimination, as result of this method, permits output voltage from a turbogenerator connected to the roller to provide true, direct linear speed measurement.





How Gates Super HC Drives can save space, weight, money on the machines you design

Ask your local Gates Man to design a drive for your machine two ways: A conventional V-belt drive and a Gates Super HC High Capacity Drive. A quick comparison will show you that the new Gates Drive costs up to 20% less than a conventional V-belt drive, weighs about 20% less and can handle your power requirement in ⅓ to ½ the space.

These advantages are possible because of exclusive, basic changes in V-belt shape and construction that permit this drive to transmit up to 3 times the horsepower of a conventional V-belt drive in the same space.

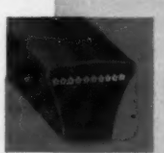
Manufacturers everywhere have standardized on the Gates Super HC Drive—the first and most advanced High Capacity Drive. It is your best assurance that your power transmission unit will remain up-to-date for many years to come.

The Gates Man, located near you, has had long, intensive training and experience in drive design. *Contact him for complete technical data on Gates Super HC High Capacity Drives and for expert drive design aid.*

The Gates Rubber Company, Denver, Colorado
BP54

Gates Super HC Drive Gives you these benefits:

- Saves up to 50% in drive space.
- Reduces drive weight 20% and more.
- Cuts drive costs as much as 20%.
- Reduces bearing load, increasing bearing life.
- Guards can be smaller, lighter weight.
- Belt speed up to 6000 ft/min possible without dynamic balancing.
- Less costly, higher speed motors can often be used.
- Jackshafts and outboard bearings can sometimes be eliminated.



Exclusive design features include: A Precisely Engineered Arched Top, Concave Sides, Flex-Weave Cover, super strength tensile construction.

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DIMENSIONALLY STABLE TO 0.00001" PER INCH

Parts in computing devices, aircraft or missile guidance systems, and electronic equipment must be dimensionally stable, sometimes to a few millionths of an inch per inch. Two factors interfere with such dimensional stability: (1) locked-up stresses and (2) growth. While there are many approaches to the solution of this problem, most involve a lot of time and trouble, but contribute little to stability of parts.

The most positive solution is the use of Precedent 71 aluminum casting alloys which may be stress relieved by heat treatment at 700°F for four hours followed by cooling in still air. This stress relieving heat treatment is applied to the raw casting and no subsequent treatment is required. After stress relieving at 700°F, Precedent 71 A and B alloys are completely dimensionally stable to 0.00001" per inch.

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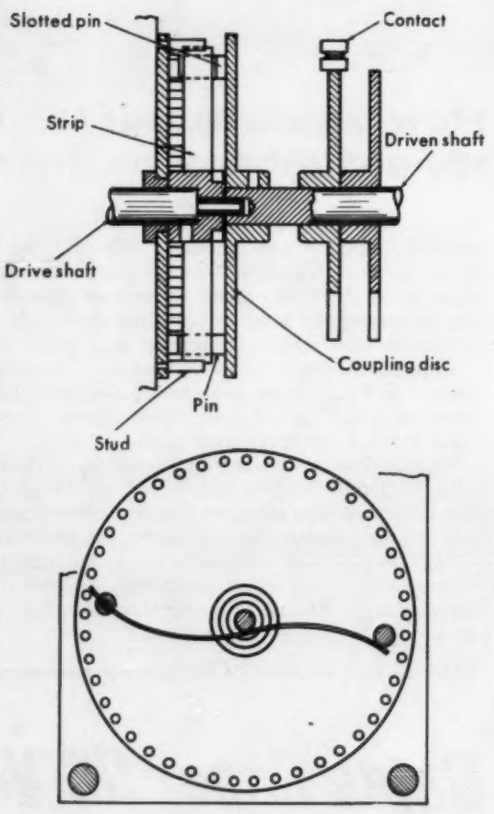
PATENTS

Switching Program Controller

Italian Patent 600,592; Angelo Ferrari, Italy.

This patent covers a motor-driven device for sequential operation of a number of electrical contacts according to a variable time program. Drive and driven shaft are coaxial with a fixed disc, which carries a number of peripheral studs. An elastic strip passes through a slot in the hub of the drive shaft, and contacts one of the peripheral studs with one end. This same end is guided through a slotted pin on a disc fixed to the driven shaft. The other strip end presses against a second (reaction) pin on the disc.

Rotation of the drive shaft causes intermittent bending of the elastic strip, resulting from passage over the peripheral studs. Each time the strip snaps from one stud to the next, the coupling disc and driven shaft are rotated slightly. Cams on the driven shaft then close the desired switches. The switching program can be varied by altering the number of studs and their spacing.



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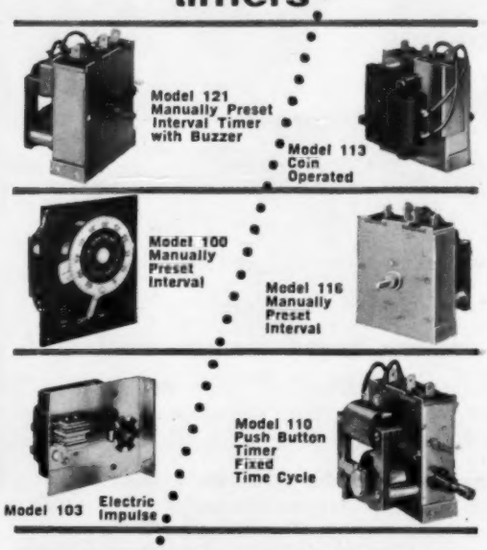

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Miller-Harris' reputation is based on two uncompromising facts: quality-made electric control timers, and their *expedient delivery!*

These factors will contribute greatly toward helping you: preserve *your* products' high quality standards, maintain *your* production schedules, meet *your* shipment and delivery dates, fulfill *your* sales objectives.

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Whether your control timer requirements are for "standards" or "specials", Miller-Harris can supply your needs exactly and follow through with the delivery service that means complete satisfaction.

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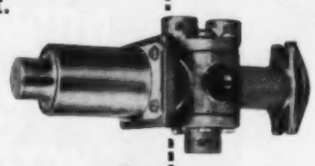

D.C. SOLENOID "SHEAR SEAL" VALVES 0 to 10,000 P. S. I.

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EXPLOSION PROOF A.C. and D.C.
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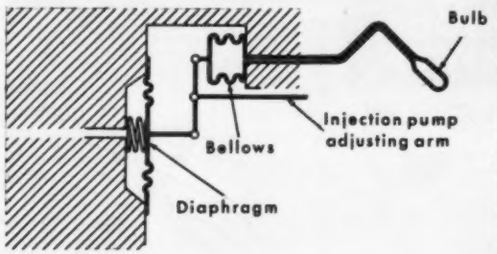
Mixture Enrichment System

Italian Patent 606,333; Alfa Romeo SpA., Italy.

The air-fuel mixture of a fuel injection engine is enriched during cold condition operation by action of a bulb filled with an evaporating liquid.

The system includes a diaphragm controlled by difference between atmospheric pressure and the pressure existing in the air intake manifold, and a bellows controlled by atmospheric pressure. Displacements of these elements are combined to control the regulating rod of the injection pump. The bellows, which has an internal pressure, is connected to a bulb partially filled with a highly evaporative liquid located in the engine cooling system.

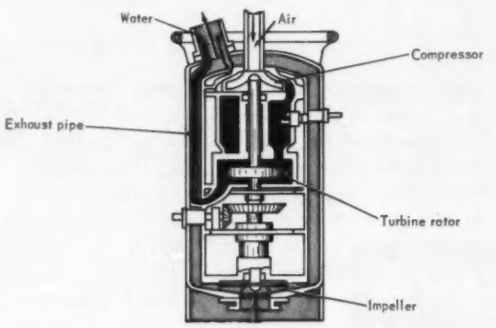


Gas Turbine Water Pump

Japanese Patent 36-2789; Shintaro Iwai, Kita-kohorijama 750, Yamatokohoriyama-shi, Nara-ken, Japan.

This patent covers a large-volume water pump driven by a gas turbine. A cylindrical housing, open at the bottom for water intake, encloses the unit. Air enters axially at the top through a single-stage compressor, moves downward into the annular combustion chamber, where it is mixed with fuel. After ignition, the hot gas flows down through the turbine wheel and is exhausted through a pipe brought up into the water discharge. The gas thus helps to lift the water, reducing power waste.

The vertical turbine shaft carries the impeller at its lower end, located just above the water intake. Starting is aided by a bevel gear pair, connecting to a stub shaft in the outer case.



NEW!
EXTENSION SWIVEL FITTINGS

PATENT APPLIED FOR

OFFERS 360° ROTATION

PROVIDES EXTENSION AND CONTRACTION OF SWIVEL END

COMPENSATES FOR THERMAL EXPANSION & CONTRACTION

DUMONT ENGINEERING has developed a new pressure balanced, low torque swivel fitting which is capable of accepting extension and retraction of its rotating end. This particular assembly achieves a full 6" extension without leakage, under high or low pressure service. In the ¼" tube size it is less than 10" in length and only ¾" in diameter. The unit offers a light weight solution in applications where it is necessary to contract a section of fluid system within an enclosure in order to seal that enclosure after internal connections have been completed. The extension feature also provides built-in compensation for linear movement due to thermal expansion or contraction.

The unit offers full 360° rotation of the swivel end and will operate at temperatures from −65° to +300°F. and pressures up to 5000 P.S.I. It is pressure balanced and therefore not subject to separation forces. The force required to extend or retract the rotating end is less than 8 lbs. when not pressurized. In a hydraulic system at 3000 P.S.I., the force is less than 14 lbs. for either rotation or extension of the swivel end. Pressure drop in the ¼" tube size is less than 5 P.S.I. at 1.2 G.P.M. flow of MIL-H-5606 hydraulic fluid at 70°F.

The unit can be manufactured in various configurations, sizes, and fitting ends. For complete information and specifications, write or phone:

DUMONT ENGINEERING CO.
Department D-4
1401 FREEMAN AVE. • LONG BEACH, CALIFORNIA
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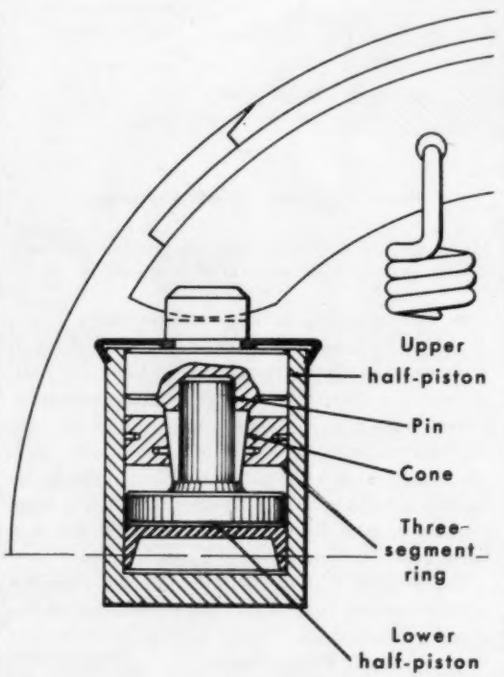
PATENTS

Brake Wear Compensator

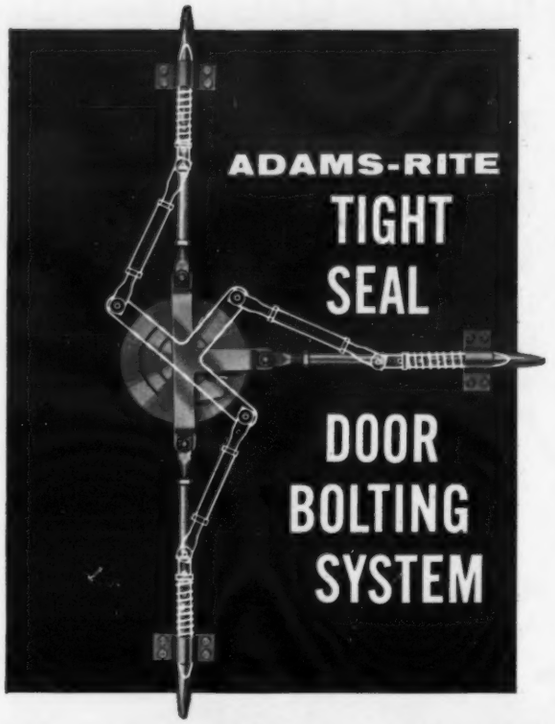
French Patent 1,244,052; Pavel Kutac and Voclav Hruska, assigned to Tatra Narodny Podnik, Czechoslovakia.

This patent describes a simple device which automatically compensates for brake wear. The device is enclosed within the brake actuating cylinder.

The piston is divided in two parts for assembly purposes. From the lower part protrudes a shaft or pin on which is freely mounted a one-piece cone. This cone can move within a three-segment ring. Its three segments are fastened by an assembly ring and forced to expand and bear on the bore surface of the cylinder by an internal expansion ring.



When brake linings are new, brake release play is provided by the distance between lower half of the piston and the three segments. If linings are worn, brake travel is sufficient to allow contact between lower half of the piston and the segments. At this point, the cone is pushed upward, freeing the segments and allowing them to be moved. When the brakes are released, the cone expands the three-segment ring and presses it against the cylinder bore.



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ADAMS RITE has been manufacturing precision mechanical products for over 50 years and is the major supplier of door hardware for the aircraft industry. A-R products are Designed for a Purpose and include locks, latches, handles, door bolting systems, tie-down fittings, and mechanical controls. Products for specialized applications are designed and manufactured to customer specifications.

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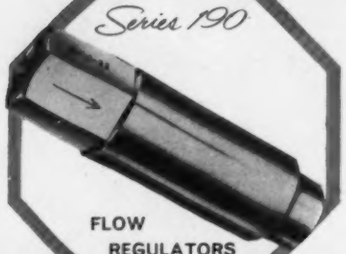
WATERMAN

Series 190



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At a cost comparable to an ordinary restrictor or needle valve, you can have pressure-compensated flow control in your hydraulic circuits.

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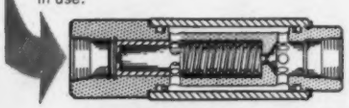

Unit senses pressure drop across precise orifice and reacts to control flow with desired limits.

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The following list compiled from recent issues of the Patent Gazette gives you increased coverage of new patents whose details may be useful to product and machine designers. Copies may be obtained from the U. S. Commissioner of Patents, Washington, D. C. The price is 25c each.

SELF-AJUSTING BRAKE OR CLUTCH MECHANISM
U S Patent 2,996,886; Dan W. Jeffries, Los Angeles, Calif., assignor of one-half to Garal Mfg. Corp.

FLEXIBLE COUPLING
U S Patent 2,996,900; Rex M. A. Fermier, Chicago, Ill., assignor to Lovejoy Flexible Coupling Co., Chicago, Ill.

INTEGRATOR BRAKE
U S Patent 2,996,920; Sprague A. Mackenzie, Orrville, Ohio, and Donald M. Stough, Penn Hills Township, Allegheny County, Pa., assignors to Hagan Chemicals & Controls, Inc., Pittsburgh, Pa.

BEVEL GEAR TRANSMISSION WITH BACKLASH CONTROL
U S Patent 2,996,929; Gustaw Lazarowicz, Toronto, Canada, assignor to Orenda Engines Ltd., Malton, Peel, Ontario, Canada.

EXPLOSIVE ACTUATED VALVE
U S Patent 2,997,051; William Warren Williams, Smyrna, Ga., assignor, by mesne assignments, to Pneumo Dynamics Corp., Cleveland, Ohio.

ELECTRICALLY CONTROLLED VALVE
U S Patent 2,997,064; Harvey F. Gerwig, Glendale, Robert M. Cox, Northridge, Fred O. Hosterman, Studio City, and Rene Rivera, Reseda, Calif., assignors to Weston Hydraulics, Ltd., North Hollywood, Calif.

FLUID-ACTUATED SHIFTABLE MECHANISM
U S Patent 2,997,066; Edwin P. Brinkel, Royal Oak, Mich., assignor to Ross Operating Valve Co., Detroit, Mich.,

ANTISKID BRAKE CONTROL
U S Patent 2,997,135; Alexander Bier, 433 Roosevelt St., Fresno, Calif.

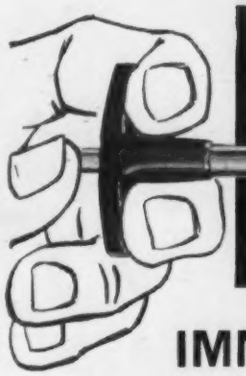
ROTARY DAMPER
U S Patent 2,997,140; Rollin Douglas Rumsey, Buffalo, and William J. Carter, Kenmore, N. Y., assignors to Houdaille Industries, Inc., Buffalo, N.Y.

OVERLOAD RELEASE COUPLING
U S Patent 2,997,149; Frederick W. Seybold, 1979 Dogwood Drive, Scotch Plains, N.J.

ACTUATORS
U S Patent 2,997,271; Wallace A. Bounds, 3726 135th Ave., S.E., Bellevue, Wash.

BRAKE SYSTEM FOR VEHICLES
U S Patent 2,997,312; Josef Mueller, Stuttgart-Riedenberg, and Joseph Dauben, Stuttgart, Germany, assignors to Daimler-Benz Aktiengesellschaft, Stuttgart-Untertuerkheim, Germany.

AIR SPRING CONTROL MECHANISM
U S Patent 2,997,314; Jennings Paul Hill, Lakewood, and Robert L. Christian, Chardon, Ohio, assignors to The Gabriel Co., Cleveland, Ohio.



AVDEL

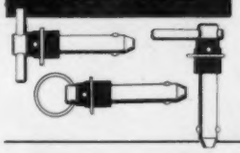
POSITIVE LOCKING · QUICK RELEASE

BALL-LOK PINS

IMMEDIATE DELIVERY

3 HEAD STYLES

DOUBLE ACTING



Double acting, positive locking, quick release Ball-lok pins with push-pull actuating head. Tapered end makes insertion easy. Safety chain is attached to body, not to handle, to eliminate accidental release. Especially suitable in difficult applications requiring extra strength, with easy release for quick disassembly. An extended plunger is optional which provides a knock-out feature when necessary. Three different handle styles are available from stock with a wide range of diameters and grip lengths. All Avdel Pins are manufactured to N.A.S. standards.

5 HEAD STYLES

SINGLE ACTING

Avdel single acting pins provide easy insertion with positive Ball-lok safety and instant release when the release button is manually depressed. They cannot be accidentally released.

Ideal for joining portable units requiring fast assembly and disassembly, with positive safety.

Eliminates the use of bolts, washers, cotter keys and rivets.

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AVDEL DETENT

You push it to insert it—pull it to release it. No tools necessary.

The Avdel Detent Pin is an economical, versatile shear pin useable in innumerable applications. The solid body construction, with spring-loaded balls, provides quick insertion and dependable removal. High shear steel insures maximum performance with safety in shear applications.

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Avdel has produced remote control pins using many types of release such as solenoid, hydraulic, lanyard and others.

This engineering can help you pre-solve your pin problems.

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One of the nation's leading manufacturers of products for the industrial, consumer and defense markets has a recently created position for an experienced centrifugal Pump Design Engineer. This position offers outstanding personal as well as professional potential with a company not now engaged in the manufacture of pumps, but of advanced systems in which pumps—(10 to 1500 hydraulic h.p. range)—are incorporated.

RESPONSIBILITIES

You will assume full technical responsibility for pump design and development, and for providing pump application data on these designs. You will also provide consulting services to engineers designing the systems in which your pumps will be used.

QUALIFICATIONS

BSME together with an MS (or the equivalent in experience). Minimum experience requirements include 5 to 10 years with a pump manufacturer—preferably in fluid mechanics and/or centrifugal pump design. You must also be able to meet and favorably impress our customers.

Location is in the Northeast. You will have full access to computers, extensive testing facilities, consultants and laboratories.

Qualified applicants will be invited to visit our facilities at Company expense. Relocation assistance will be provided. Additional information about our extensive benefits program for employees and dependents will be provided.

Please include enough information about your education and experience to justify further consideration for a position of this salary and responsibility level. All qualified applicants will be considered for employment without regard to race, creed, color or national origin. SJ-549

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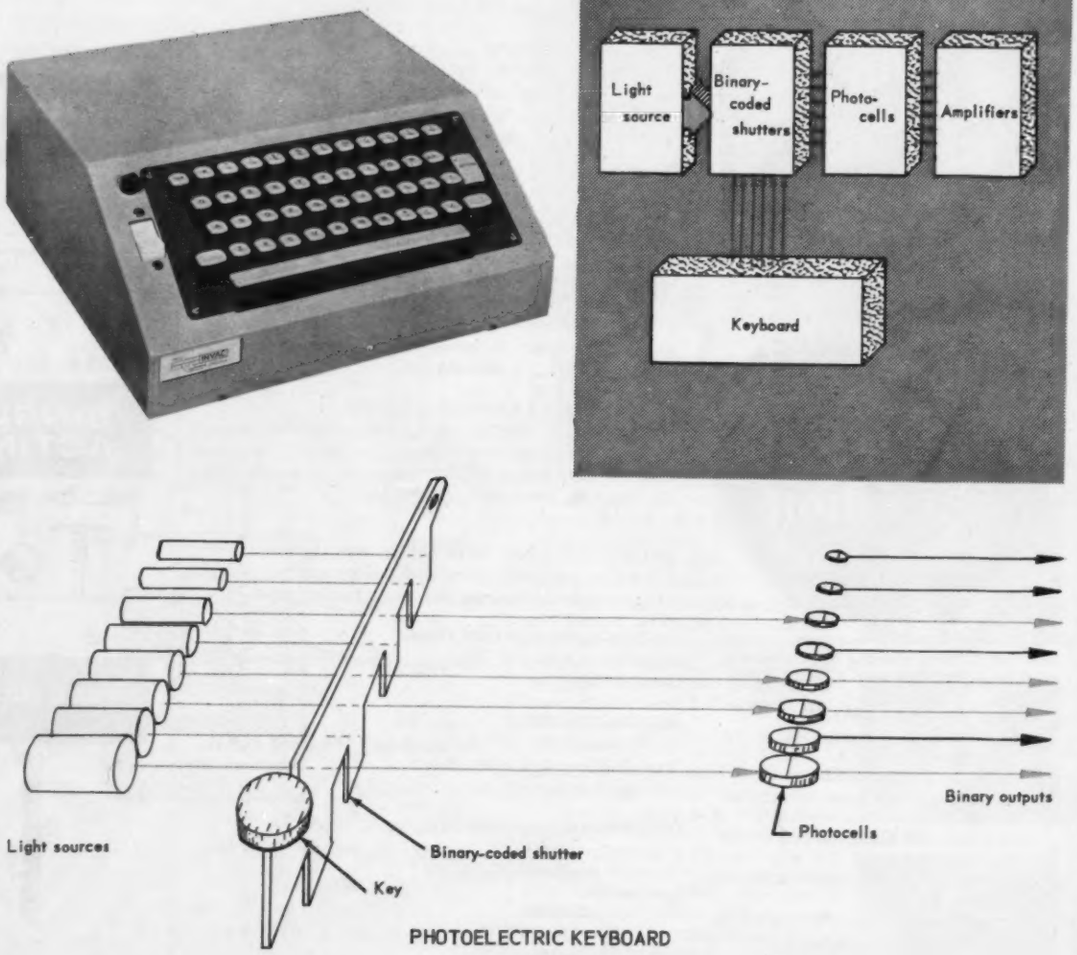
DESIGN IDEAS NEWS

ELECTRICAL

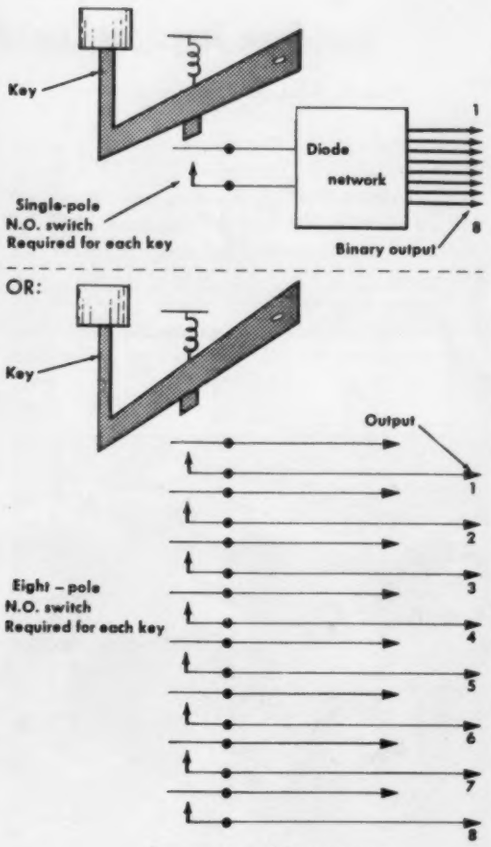
Photoelectric Switching Generates Binary Code

Victor W. Wigotsky, Eastern Editor



PHOTOELECTRIC KEYBOARD

POTENTIAL PROBLEMS associated with contact bounce and wear are eliminated. Signals can be used to punch paper tapes or cards or to interrogate data processor memories. Sketch shows arrangement for binary-coded output of 2, 5, 7, and 8. Depression of key causes modulation of light channels according to binary code of particular shutter. Resultant binary-coded light data produces resistive changes in bank of photoconductors corresponding to light channels. Blocking off of light will allow transistor to either saturate or be cut off depending on polarity desired. Amplifier circuitry converts photoconductor outputs to electrical input signals. Keys can be dual logic by use of upper and lower case. Keyboard includes shift, tab, carriage-return and space capability. Key interlock prevents simultaneous depression of more than one key. Ten available data channels permit combination of code data and strobe, dual key logic, tab and shift signals. Amplifier threshold requires positive key depression to produce usable signal. This assures complete light channel interception and thus prevents spurious signals.



Conventional keyboard

CONVENTIONALLY, normally open switch is required for each key, depression of which closes circuit to diode network to provide binary output. Another method utilizes 8-pole normally open switches for each key for selection of binary code.

An alpha-numeric keyboard uses binary-coded shutters and photocells to generate electrical inputs for data-processing equipment. No encoding matrices, contacts and switches are required.

The photoelectric method is used with a standard 44-key alpha-numeric keyboard. Binary coding is achieved with a light source, hermetically-sealed cadmium-selenide photocell and a shutter placed between them. When a key is depressed, the associated binary-coded shutter modulates a bank of photocells corresponding to the binary code used. The method permits generation of any standard or special 5-, 6-, 7- or 8-bit binary code.

The K-144 photoelectric binary encoding keyboard was designed by Invac Corp., Natick, Mass.

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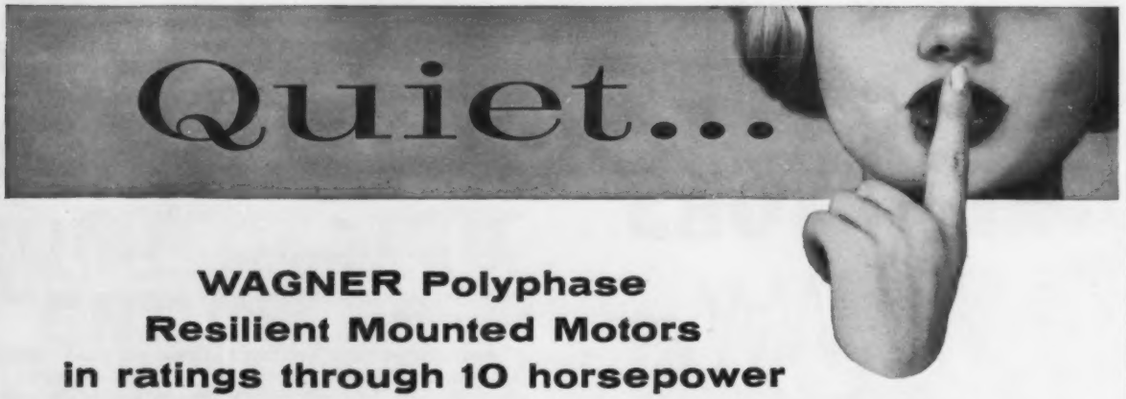

WAGNER Polyphase Resilient Mounted Motors in ratings through 10 horsepower

Quiet, vibration-free performance is essential when motors are installed in areas where noise must be held to a minimum . . . in hospitals, churches, schools, office buildings, restaurants and similar locations where quiet is needed or wanted.

Such installations have created a need for larger polyphase motors that whisper while they work. Wagner has met this need by expanding its line of polyphase resilient mounted motors to include standard ratings through 10 hp.

You certainly have applications that call for a smooth running motor, cushioned by resilient mountings. To make sure they're quiet, specify Wagner Polyphase Resilient Mounted Motors. Only Wagner can provide an entire range of ratings through 10 hp.

Constant research and development have kept Wagner up front in electric motor design for more than 65 years . . . made the name Wagner one you can depend on in choosing electric motor drives.

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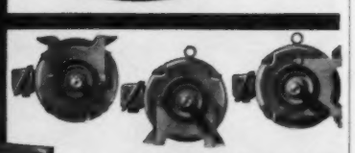
WH60-1A

SLEEVE OR BALL BEARING
These motors are furnished with quiet running steel-backed babbitt-lined sleeve bearings of high load carrying capacity. Ball bearings can be supplied when desired.



CEILING, SIDEWALL OR HORIZONTAL MOUNTING
You can mount these motors on walls or ceilings by rotating the cradle base 90° or 180°. Motor stays dripproof.

NEOPRENE CUSHIONING RING
Annular mountings, of oil-resistant neoprene bonded to steel rings, cushion the motor in its cradle base to absorb the small amount of vibration that remains in the most carefully balanced motor.

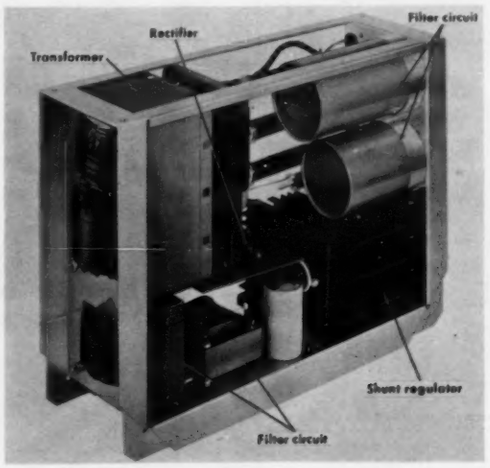
Circle 56 on Reader-Service Card for more information

Shunt-Type Transistor Control

Lars G. Soderholm, Midwest Editor

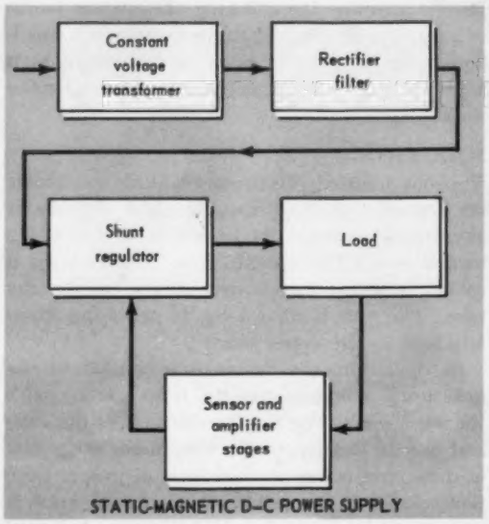
Close regulation of a static-magnetic d-c power supply is provided by the addition of a shunt-type transistor control. In this control, output voltage errors at the load are detected, amplified and fed to the transistorized shunt regulator for correction.

This constant d-c power supply consists of the conventional constant voltage transformer with a magnetic shunt between the primary and secondary windings. By suitable choice of the various parameters involved, an essentially "square" output voltage wave shape results. A silicon rectifier has been selected, enabling the optimum rating of the rectifier to be used since the static-magnetic regulator limits surge currents. A filter choke and filter capacitor selected on the same basis are also part of the d-c power supply.



The heart of the system is the transistorized sensor and shunt regulator circuit. The voltage sensor and preamplifier can be connected to the load or power output terminals. Errors are detected by comparing the output to the voltage of a temperature-compensated Zener diode. A series of transistor preamplifier stages feeds the error to the transistor shunt regulator to produce the proper amount of shunt current in order to maintain output voltage equilibrium. Control of the voltage output is through a "closed-loop" or feedback form of regulation.

Regulates D-C Power Supply

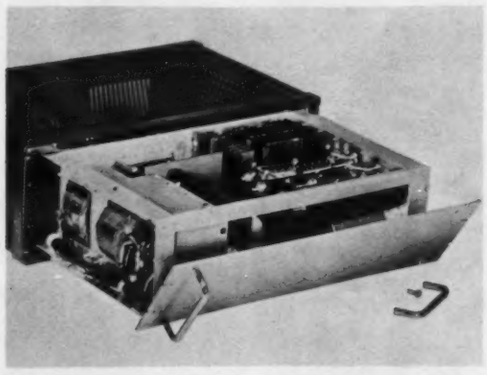


STATIC-MAGNETIC D–C POWER SUPPLY

This method of control is claimed to offer high performance characteristics in an economical, reliable unit. Advantages of this power pack are: it is short-circuit proof, and in the event of an open circuit, the transistors lose their bias and the system reverts to a conventional static-magnetic constant voltage d-c power supply. The load cannot be subjected to sudden high voltages resulting from failure of the transistors.

The CVQ transistorized static magnetic d-c power supply provides output regulation of ±0.04 percent static-load regulation, no load to full load.

The new transistorized power supply is available from Sola Electric Co., Elk Grove Village, Ill.



Flick-Reedy . . . *Winner of "Plant of the Year" Award and "Silver Anvil" Public Relations Award*

Miller

MORE SAVINGS!

Our ultra-modern, new "Plant of the Year" with its special facilities and operating economies enable us to offer an **extra 10% price savings** on our big "stock" selection of:
Model "H" (Hyd.) Cylinders, 1½" through 8" bores;
Model "J" (Hyd.) Cylinders, 1½" through 14" bores;
Model "A" (Air) Cylinders, 1½" through 14" bores.
Strokes up to 36", cushioned and non-cushioned.

Full Details On Request

Miller Hydraulic Cylinders make impossible applications look easy. With Teflon Seals, Case-Hardened Rods (50-54 Rockwell C), Patented "Shef" Tubing End Seals, and other exclusive *standard* features, these cylinders are practically damage-proof, are ultra-dependable under pressure and temperature extremes, and provide leakproof sealing with ALL hydraulic fluids. Built to *exceed* J. I. C. Specifications, these cylinders are achieving new highs in production and operating economies in thousands of plants. Two great lines: Power-Packed Model H for 3000-5000 psi and Job-Rated Model J for 500-2500 psi. All bores, strokes and mounting styles. Big "Stock" selection for immediate shipment at substantial savings.

Write for literature.

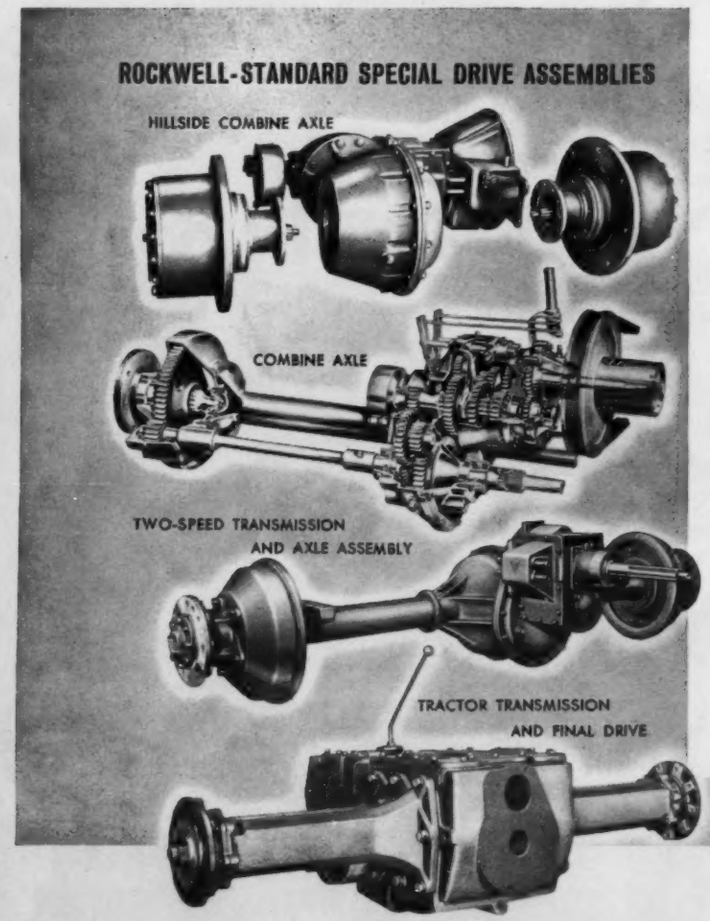
R

MILLER FLUID POWER
DIVISION OF FLICK-REEDY CORPORATION
7N020 York Road, Bensenville, Illinois
AIR AND HYDRAULIC CYLINDERS · ACCUMULATORS
COUNTERBALANCE CYLINDERS · BOOSTERS

Circle 57 on Reader-Service Card for more information

ROCKWELL-STANDARD

...the people who are specialists in driving assemblies for farm equipment!



Building drive assemblies for today's advanced new farm implements is complex, specialized work. That's why leading implement manufacturers assign this important task to Rockwell-Standard—the axle specialist.

Rockwell-Standard's Transmission and Axle Division is famous for meeting the exact drive assembly specifications of farm equipment manufacturers. Often this can be accomplished at substantial savings in both time and money by simply modifying an existing design to meet the manufacturer's requirements.

If you design or build farm equipment, find out how Rockwell-Standard's *specialized* engineering, designing and manufacturing facilities can help you get better results at lower cost. Your inquiries will be answered promptly.

Another Product of... ROCKWELL-STANDARD CORPORATION

Transmission and Axle Division, Detroit 32, Michigan

Circle 58 on Reader-Service Card for more information

Transducer in Pivoted Sphere

E. J. Stefanides, Central States Editor

PROBLEM:
Design a device for checking the surface finish of a concave hemisphere at the bottom of a small-bore hole. The device must be capable of high accuracy and of being actuated from outside the work piece.

SOLUTION:
A probe-actuated, electromechanical transducer in a small spherical capsule. The capsule is mounted in pivots at the bottom of an accurately turned tube. The sphere is in contact with a rubber belt that travels over sheaves within the tube. The belt is driven by an actuating knob attached to the upper sheave.

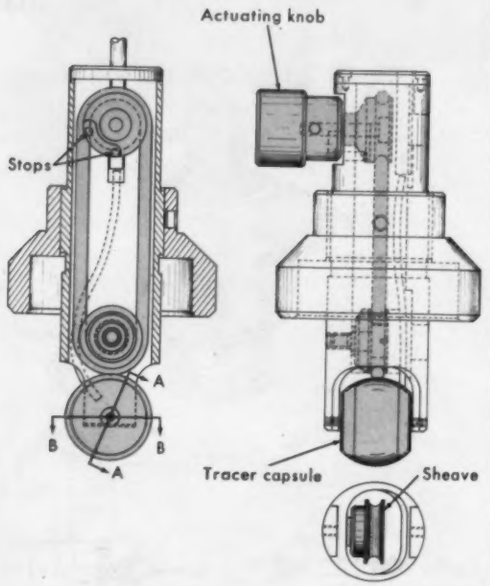
In operation, the device is lowered into the hole until a boss at the top is in contact with the work piece. The precise diameter of the tube and precise location of the boss places the probe of the sphere-mounted transducer in proper position relative to the surface. An actuating knob is then rotated between stops, driving the belt and rotating the spherical capsule by friction.

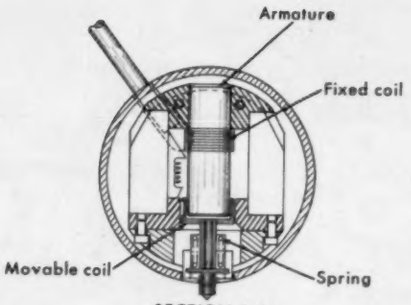
As the capsule rotates, the small-diameter diamond-stylus of the probe causes a displacement of the transducer coil within a permanent magnet field. The resulting electrical signal is fed to an electronic amplifier and displayed on a calibrated meter. Maximum deflection of the meter needle indicates maximum deflection of the probe tip.

Tracer and amplifying system were designed and manufactured by Micrometrical Mfg. Co., Ann Arbor, Mich.

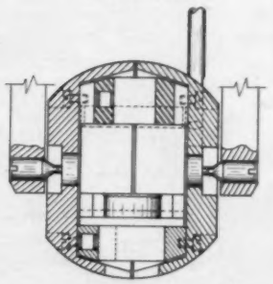
PROFILE TRACER and amplifying system. Probe tip travels approximately 0.015 inch.

Checks Surface at Bottom of Hole





SECTION A-A

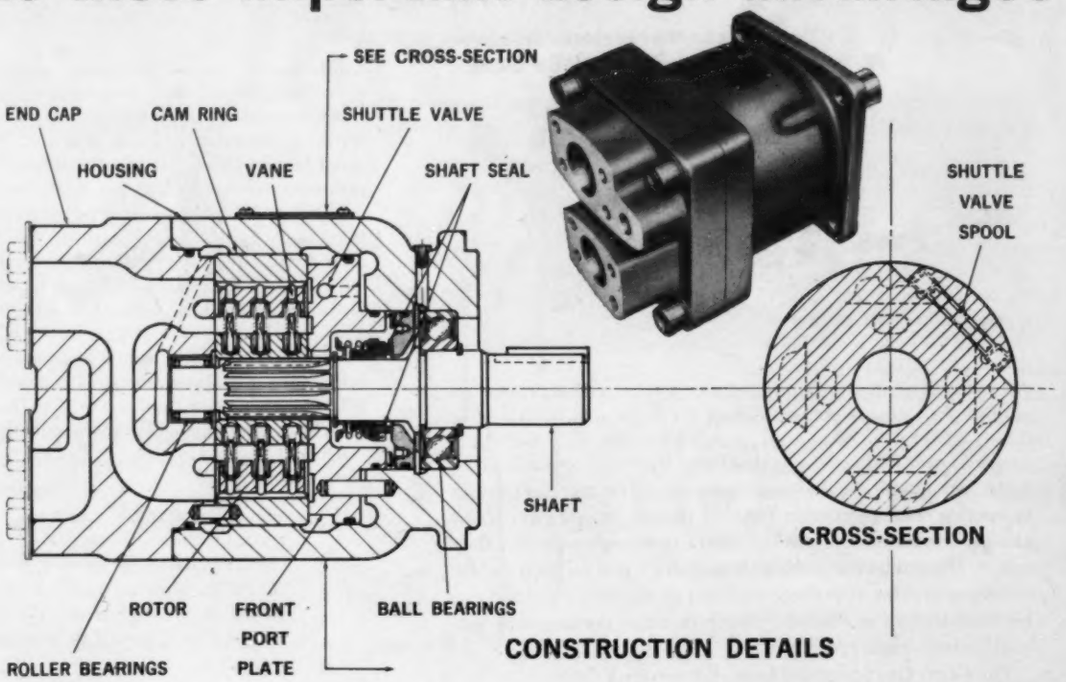


SECTION B-B

SPHERICAL CAPSULE is friction-driven by rubber belt actuated by knob. Stops limit sweep of probe stylus to surface being checked. Section through spherical capsule shows coil and magnet. Stylus is lightly spring-loaded to hold it in contact with surface.

FOR HYDRAULIC ROTATING POWER:

New 2000 psi balanced-vane fluid motor has these important design advantages



By: Robert A. Manogue

Pumps/Controls Product Manager
Denison Engineering Division
American Brake Shoe Co.

Today's demands for efficient, low cost hydrostatic power transmissions are growing rapidly. Design engineers have, in turn, demanded reliable vane-type fluid motors that are compact, lightweight and efficient for their hydraulic rotating power needs.

COMPACT 1 LB. PER HP RATIO

The new Denison "M1D" Series floating cartridge, balanced vane/balanced rotor fluid motor shown here is one of 5 sizes available. They are excellent choices for service up to 2000 psi at speeds up to 2000 rpm and for hp ranges up to 75. Unit size is a highly compact 11 11/16" long by 6 1/8" square—including normal keyed shaft extension. Weight is under 75 lbs., affording an efficient 1 lb. per horsepower ratio.

The five motor sizes offer a range of maximum theoretical torques of 1249, 1719, 1897, 2160 and 2345 lb.-in. at 2000 psi.

BALANCED VANES AND ROTOR

The pumping cartridge (vanes, rotor, cam ring, front and rear port plates) offers high efficiency power transmission through the motor shaft by symmetrically balancing the rotor and vanes 100% for axial thrust in both directions. Radial vane balance is approximately 80%—imparting a 20% pressure loading to the vanes as outward force against the cam ring to allow following the cam contour. By a unique combination of spring loading and oil porting control, vanes are balanced outward during their entire pumping period. This balance is produced by a combination of centrifugal force, spring loading and partial pressure loading.

Denison's vane design (two contoured sealing lips) also means effective control of cross-port leakage during work stroke on the major cam ring diameter. This leakage is normally inherent in most other fluid motors.

SHUTTLE VALVE CONTROLS CARTRIDGE LOADING

Clamping forces are imparted to these new M1D fluid motors by a unique shuttle valve, interconnected with the motor's two external ports. This valve shifts automatically to maintain the highest pressure available to the front port plate in order to control motor cartridge clearance axially. This special design always ports highest pressure oil to the rear of the front port plate—providing controlled cartridge loading that gives peak efficiencies and permits starting at any temperature.

FOUR OTHER DESIGN ADVANTAGES

Four other important features of the Denison M1D Series: (1) A 100 psi mechanical shaft seal. (2) Extremely wide bearing spacing to permit full shaft side loading—up to 795 lbs. side load. (3) Angular alignment is achieved by means of snug fit dowel pins. (4) Designed for SAE requirements—including 4-bolt SAE mounting pad, SAE spline shaft and SAE fluid connections. The main motor connections are 1¼" SAE fluid pads. Drain connection is 9/16"—18 UNF2B thread for ⅜" tube size.

NEW SPECIFICATIONS BULLETIN FOR DESIGNERS AND ENGINEERS

Write for your copy of Bulletin FMV-1 on new Denison M1D Series Vane-Type Fluid Motors. Includes specifications, operating and application data, performance figures on this new 2000 psi equipment.

DENISON ENGINEERING DIVISION
American Brake Shoe Company
1190 Dublin Road • Columbus 16, Ohio

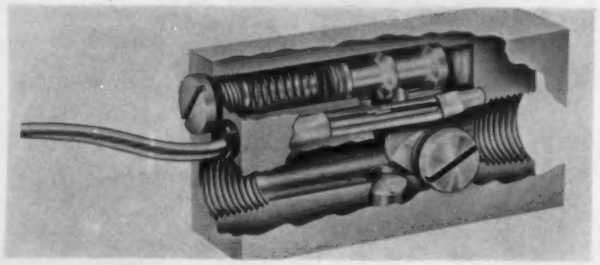
Circle 59 on Reader-Service Card for more information

DESIGN NEW PRODUCTS NEWS

Circle number on Reader Service card for more information

Adjustable Flow Switch 301

Detects Variations in Flow Rate of Fluids or Gases

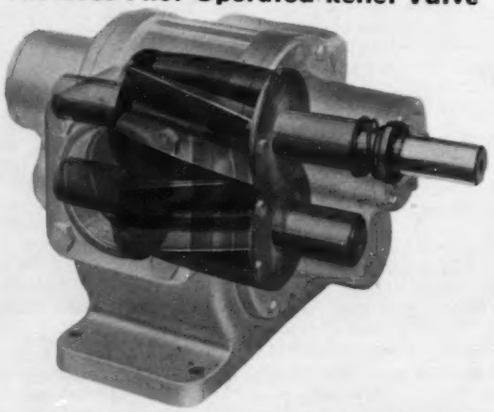


An externally adjustable, vane-type, bypass valve provides a continuous range of actuation from 0.1 to 10 gpm for fluids (or 0.5 to 30 scfm for gases) on Model FS-10798 flow switch. A magnet-equipped shuttle is displaced by fluids or gases to actuate hermetically sealed switch contacts. The unit can be used to operate remote warning lights or to give warning or control at a predetermined flow when used in conjunction with a flow meter. The unit comes with a 1/2-inch NPT port on each end for in-line operation. Housings are brass or stainless steel and can be furnished in aluminum, plastic or other nonmagnetic material to individual specifications.

The Gems Co., Sheppard Lane, Farmington, Conn.

High-Capacity Pump 302

Features Pilot-Operated Relief Valve



Use of heat-treated, high-tensile, aluminum alloy in construction of the Figure 3638 pump reduces its weight by 50 percent. Weighing only 110 lb, the unit has a capacity of 345 gpm at 900 rpm. Operating pressure is 100 psi on fuels and 125 psi on lubricating oils. Compact size and flanged straight-through porting require minimum space for mounting and connections. The pump can be direct-connected to a standard-speed electric motor, geared head motor or gasoline or diesel engine. Because the unit will handle a wide variety of fluids, it finds application in the petroleum and process industries. A feature of the pump is its improved relief valve—a pilot-operated type which is unaffected by speed, flow or change of flow rate and which requires no additional space. Setting and adjustment are simple and the unit has a low differential pressure from full flow to full shutoff. Faceplate and backplate castings, as well as flanged bearing bushings, are interchangeable to simplify repair. Hardened chrome-iron pumping gears are cast integrally with case-hardened alloy-steel shafts. This construction promotes accuracy, quiet operation and long pump life. Operation may be in clockwise or counterclockwise rotation. The pump is available with high or low drive.

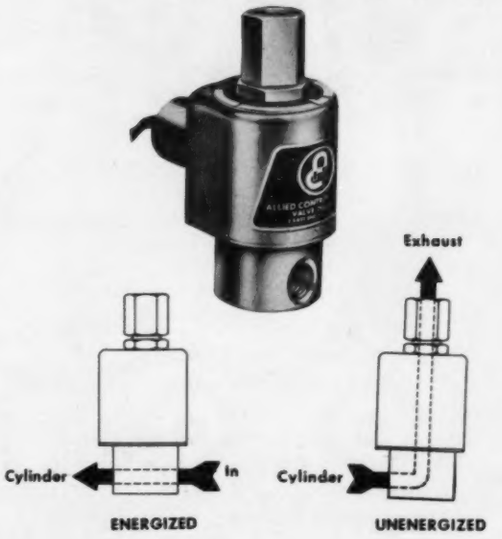
Roper Hydraulics, Inc., Commerce, Ga.

Miniature Solenoid Valve 303

Handles 0 to 200-PSI Pressures

Available in normally closed, normally open, directional and free-venting versions, a miniature three-way solenoid valve series is designated Type BM-300. The small brass valves will handle differential pressures from 0 to 200 psi or up to 500 psi for special applications. The cylindrical brass body is 1-3/16 inches in dia and 7/8 inch deep. Five body orifice diameters of 3/64, 1/16, 3/32, 1/8 and 5/32 inch have Cv factors of 0.05, 0.12, 0.21, 0.32 and 0.40, respectively. Ports are 1/8 inch NPT. Coil voltages are available from 6 to 440v a-c or 6 to 220v d-c. Burst pressure is rated at 6000 psi. Operating time is 8 to 12 millisec. Weight is approximately 15 oz complete.

Allied Control Co., Inc., 2 E. End Ave., New York 21, N.Y.

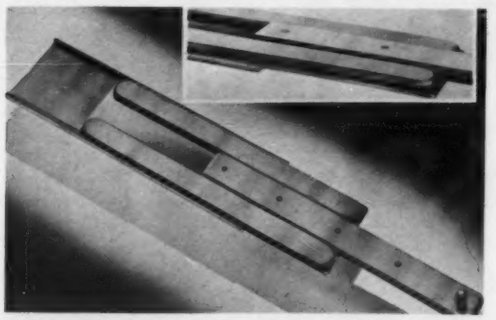


Ultrathin Circulating Ball Slide 304

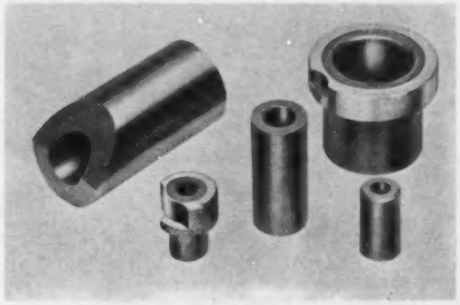
Uses Vertical Race

Substantial reduction in overall slide width is obtained by vertical positioning of the race in Model CBV, ultrathin, circulating, ball slide. A former model, CB, uses a horizontal race. Load capacity of Model CBV is 500 lb. Weight distribution characteristics make this slide suitable for applications where shock and vibration are likely to occur. Standard sizes range from 16 to 24 inches and mounting can be done with standard hardware. The ball slide will handle standard "Chassis-Trak" sizes.

Chassis-Trak, Inc., 525 S. Webster Ave., Indianapolis 19, Ind.



Carbide Bushings 305



For applications where bushings are subject to extreme wear, carbide bushings offer accurate hole location over a longer period of time with the added advantage of longer drill life. A second feature is decrease in machinery down time for changing bushings on high-production runs. The complete bushing line includes ASA standards; thin-walls; "Trans-Lok", and "Press-Lok" with serrated OD for use with plastics and ductiles.

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.

Miniature Servo 306

A miniature servo, designated Model 100-2, is designed for use in both analog and digital systems for airborne and shipboard navigation and similar systems. The servo includes a control transformer, motor-tachometer, amplifier, shaft encoder and gear train. The unit weighs 12.5 oz and measures 3-1/2 by 1-3/4 inches.

Librascope, Div. of General Precision Inc., Glendale, Calif.

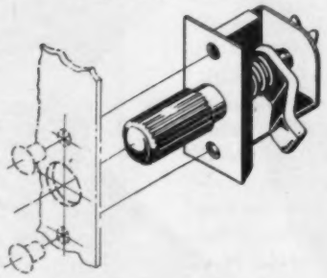
It's a good design, but

how will you fasten that panel?

Design a package that no standard fastener will fit, and you'll need a special device. We design and build specials. But standards (like those shown here) cost less and get there sooner.

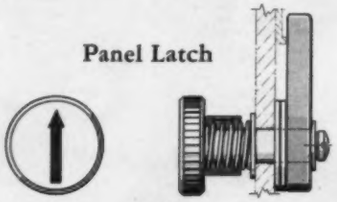
56 pages of standard fasteners in our new Handbook No. 11* Send for one... it's free. Write Southco, 232 Industrial Highway, Lester, Pa.

Adjustable Fastener



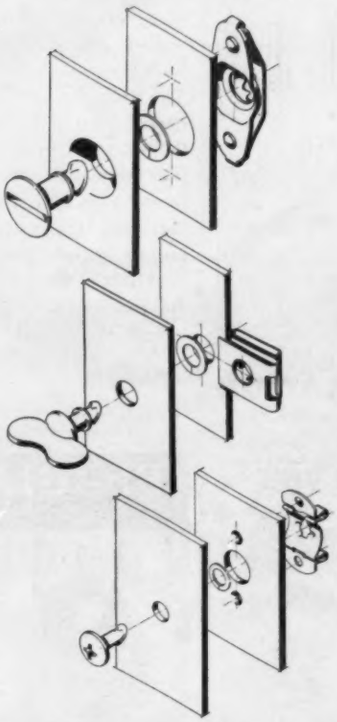
Best Application: To compress a gasket, resist vibration, fit varying frame thicknesses.
Form: One piece latch installed by passing knob through door. Quarter turn opens or closes. No striker required.
Features: Further turning of knob changes grip to hold different frame thicknesses, tightens door against gasket.
Availability: From stock in 4 sizes, miniature to large. *Handbook pp. 28-37.

Panel Latch



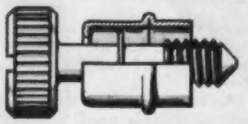
Best Application: Where spring loading, single hole mounting, and minimum inside clearance are factors.
Form: Chromed knob with arrowhead to indicate pawl position. Spring in plated ferrule applies tension to pawl.
Features: Uses only 3/16" inside space. Pushing knob relaxes operating tension.
Availability: From stock, individually packaged. *Handbook pg. 43. Other latches, pp. 38-43.

Lion 1/4 Turn Fastener



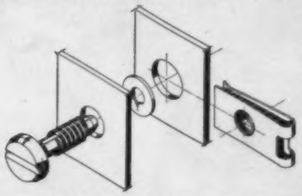
Best Application: For light weight, quick operation, vibration resistance. To meet Mil Spec. MIL-F-5591A (ASG).
Form: Swaged nose stud, retainer (to captivate stud), solid leaf receptacle.
Features: Quarter-turn clockwise locks, quarter-turn counterclockwise unlocks. One piece stud design adds considerable strength. Clip-on receptacle speeds installation.
Availability: From stock in variety of head styles. Ten receptacles offered over the three sizes, including side-mount and casting mount. *Handbook pp. 9-18.

Retractable Screw Fastener



Best Application: Drawers, slides, doors, especially on electronic equipment.
Form: Polished stainless steel screw retained in standoff flanged into door. Screw engages tapped hole in frame.
Features: Screws can be used in multiples, operated individually without forcing door. Float of screw in standoff tolerates misalignment.
Availability: From stock in 5 head sizes (slotted or unslotted), 8 thread sizes from 1/4-20 to 4-40. Spring loading for automatic retraction also from stock. *Handbook pp. 18-22.

Quick-opening Screw Fastener



Best Application: Where misalignment is present, or where doors may be subject to hard use or deformation.
Form: Heavy square-threaded screw assembly held in outer panel by retainer and engaging receptacle on frame.
Features: Maximum float for ease of installation and alignment. One assembly fits variety of door and frame thicknesses.
Availability: From stock in Nos. 2 and 7 sizes. Three head styles; riveted, welded, clip-on receptacles. *Handbook pp. 23-27.

SOUTHCO FASTENERS
LION

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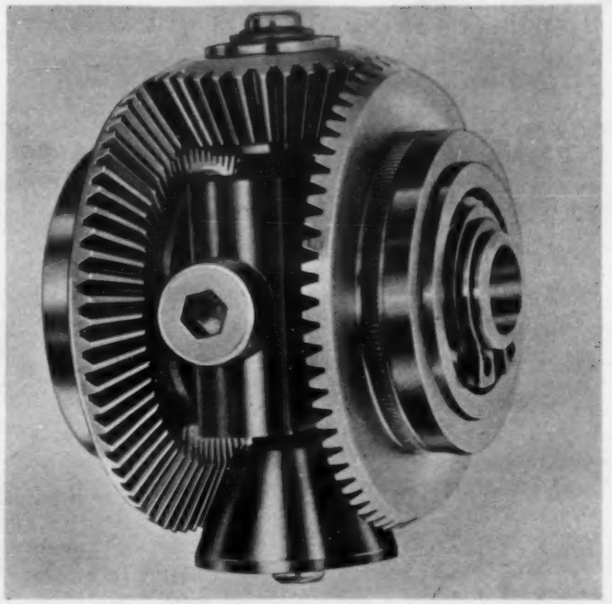
Circle 60 on Reader-Service Card for more information

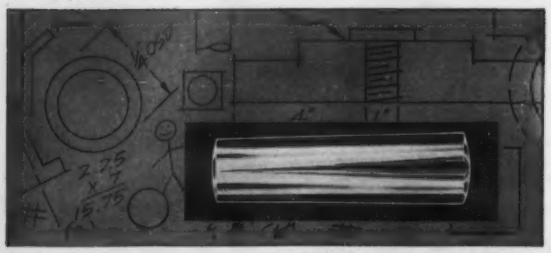
Hollow-Shaft Differentials

307



Clearance circles down to 1 inch or less are provided by a new line of precision hollow-shaft differentials designed for computers and control instruments. Construction is of stainless steel except where aluminum spider gears are specified. Miniature ball bearings conform to ABEC 7 tolerance requirements. Differentials are precision balanced and may be obtained with 0.1248-, 0.1873- or 0.2498-inch bores in narrow and standard width. The units can be supplied with end gears made from flat blanks parallel within 0.0002 inch. Pitch and number of teeth for end gears may be selected from a wide range. Gears are mounted with true lock serration. Other features of the differentials include: central builtin clamping, backlash of 8 minutes or less as required and breakaway torque of 0.3 oz-in or less.

Instru-Lec Corp., 520 Homestead Ave., Mt. Vernon, N. Y.



DON'T DISPOSE OF DOODLES
if they pertain to fastening problems

Next time you're sketching out a problem, give Driv-Lok a crack at it. We can pin down quite a bit of helpful information from a doodle.

We'd like to know what the application is, dimensions, metals used, and any pertinent factors such as shock or vibration, corrosion, electrical properties... the things needed to let us give you a proper pin recommendation and a price.

Driv-Lok's wide variety of grooved pins and agile engineering ability have solved a multitude of fastening problems. We'd like a chance at yours.

***8 STANDARD TYPES PLUS SPECIALS** In a variety of metals. Send for your free catalog and samples, too.*

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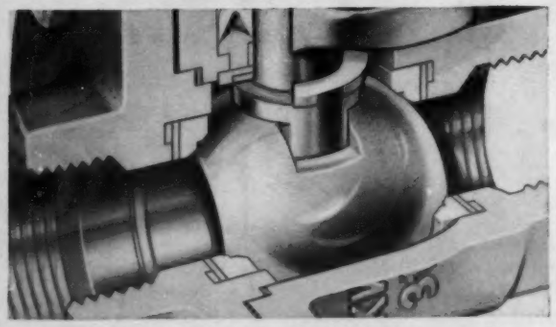
IN ROCKWOOD BALL VALVES



Rubber or Teflon Seats?

Rubber outperforms all other materials. It is tough, abrasion-resistant... seals tighter, longer. Teflon is used only for corrosion and high temperature resistance.

Whether Teflon or rubber is used, *Rockwood Ball Valves* are best for all applications. Rockwood Ball Valves have larger waterways per valve size, a wider choice of valve types and the most durable construction.

For details write Rockwood Sprinkler Company, Ball Valve Department, 856 Harlow Street, Worcester 5, Mass. Distributors in all principal industrial areas. Rockwood Sprinkler Company, A Division of The Gamewell Company, A Subsidiary of E.W. Bliss Company.

ROCKWOOD

BALL VALVES

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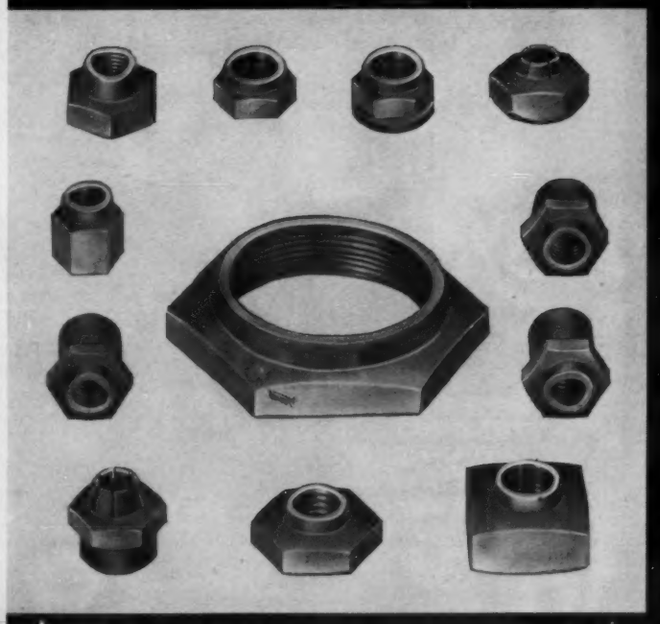
SPECIAL LOCKNUTS ... *that solved fastening problems*



As the largest specialized nut manufacturer in the world we are constantly developing new methods and products for this phase of assembly in industry... in the field of locknuts we have made spectacular progress. Besides standardized hexagon "Conelok," "Huglock" and "Marsden," sizes #10—3" of ferrous and non-ferrous materials, we provide many special application nuts, upon a basis of these designs... a few of which are here shown... Our sales and engineering departments are available to help you solve your fastening problems... Send for 12-page condensus catalog, it includes complete specifications of our entire product, as well as engineering data. We also have an one hundred and forty four page catalog where more comprehensive information is required.

Manufacturers of Standard and Special ferrous and non-ferrous Hexagon, Square and "12 Pointer" nuts... "Conelok," "Huglock" and "Marsden" locknuts.

NATIONAL MACHINE PRODUCTS COMPANY

an sps company 44250 UTICA ROAD UTICA, MICHIGAN

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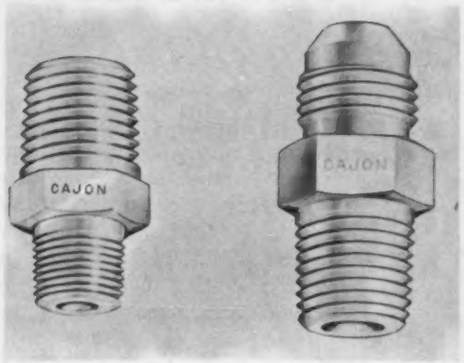
Plastic Pipe Fittings 308



Precision fittings are furnished in the following plastics: "Zytel" (nylon), "Teflon", PVC, "Profax", polyethylene, "Plaskon", "Penton", "Kel-F" and "Delrin". The plastic units overcome problems of corrosion, chemical reaction, vacuum-line leakage, electrical insulation and weight reduction. Offered in a variety of shapes, the fittings range in size from 1/16- through 1-inch nominal pipe size.

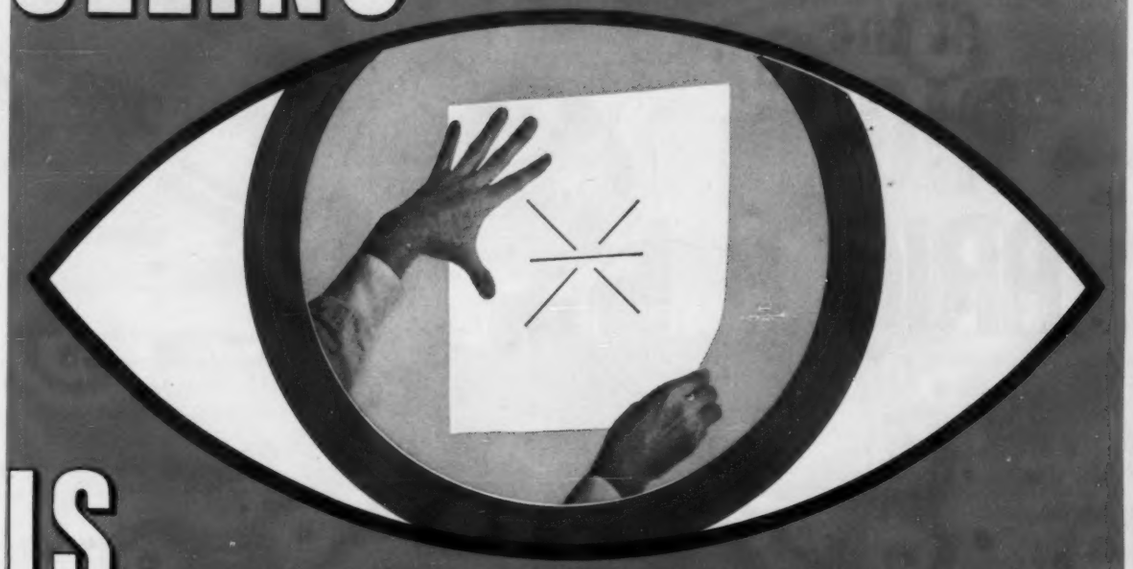
Cajon Co., 902 E. 140th St., Cleveland 10, Ohio.

Explosionproof FHP Motors 309

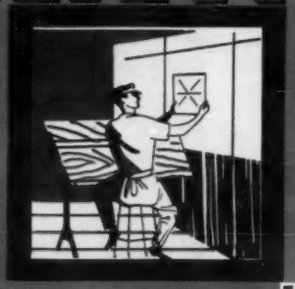
Subfractional horsepower motors are available in one-, two- or three-phase induction or synchronous types from 1/150 to 1/20 hp. Torque or dynamic-brake types also are offered. Two-, four- and eight-pole models give corresponding synchronous speeds of 3600, 1800 and 900 rpm. Rotary components have been UL approved for operation in Class I, Group D and Class II, Groups F and G environments.

Holtzer-Cabot Motor Div., National Pneumatic Co., Inc., 125 Amory St., Boston 19, Mass.

SEEING



IS BELIEVING!



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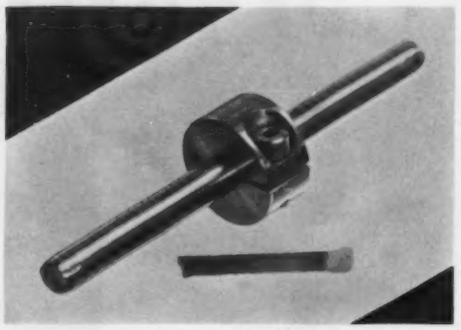
MECHANICAL

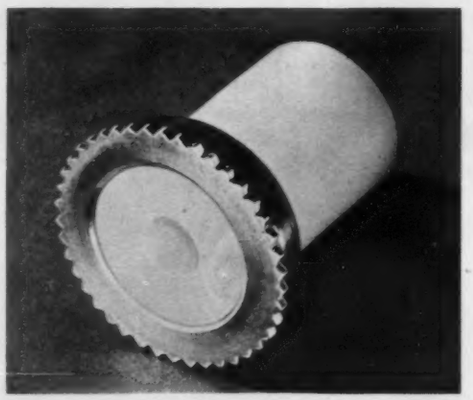
Clamp-Type Shaft Collar 310



Offering a greater holding force than set-screw collars, this clamp-type unit is manufactured in sizes from 1/16- to 1-inch bore. The device may be repositioned accurately without burring the shaft. Clamping screw may be safety wired. Useful with thin-wall tubing, the collar is balanced accurately and may be obtained in steel, aluminum and stainless.

R. D. Maxwell Co., Box 64, Winchester, Mass.

Self-Clinching Standoff 311



An insulated standoff is manufactured of "Delrin" which features high dielectric and tensile strengths and good stability to creep or cold flow. Use of the standoff can simplify assembly problems and effect savings in time and labor. Aluminum types may be mounted in materials having a Rockwell hardness of B-50 or less; steel and stainless types, B-70 or less. The unit has a self-locking feature for the attaching screw and is available in lengths from 1/2 to 2 inches in thread size 6-32.

Spyraflo, Inc., subsidiary of Penn Engineering & Mfg. Corp., Drawer "E", Miami 64, Fla.

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Mueller Brass Co. of Port Huron is much more diversified than the name "Brass" implies . . . a lot more. In fact, because of its many and varied facilities . . . its *men, methods* and *metals* . . . Mueller is in the unique position of being able to offer true single source service.

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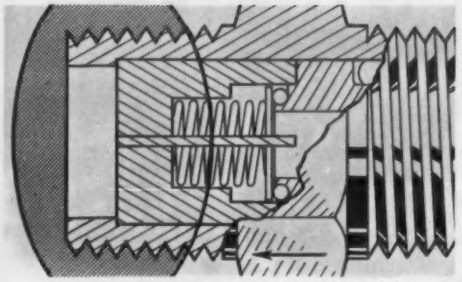
In addition, Mueller Brass Co. has complete and modern facilities for performing all types of finishing and sub-assembly operations. Another plus value is nation-wide sales engineering service.

So, in the final analysis, no matter where you fit in the American industrial picture, whether you're making missiles or mowers . . . and no matter where you're located, it will pay you to LET MUELLER MAKE IT!

MUELLER BRASS CO.
PORT HURON 23, MICHIGAN

Circle 66 on Reader-Service Card

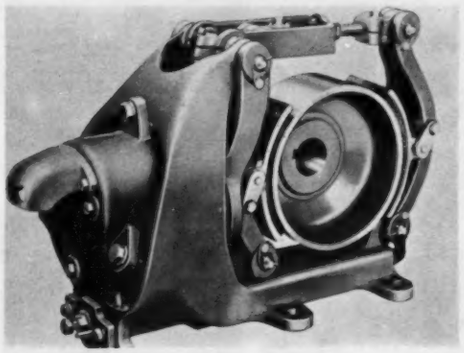
Check Valves 312



This type of check valve, designated the 1500 series, is housed in a standard hex nipple. Opening pressure is 2 psi. The open-type construction provides good flow characteristics. The valves are stocked in brass in 1/4-, 3/8- and 1/2-inch NPT. O-rings are made of "Buna-N" rubber and both spring and disc are of stainless steel.

Bodnar & McDermott Mfg. Co., Inc., 19 Beechwood Ave., Mt. Vernon, N. Y.

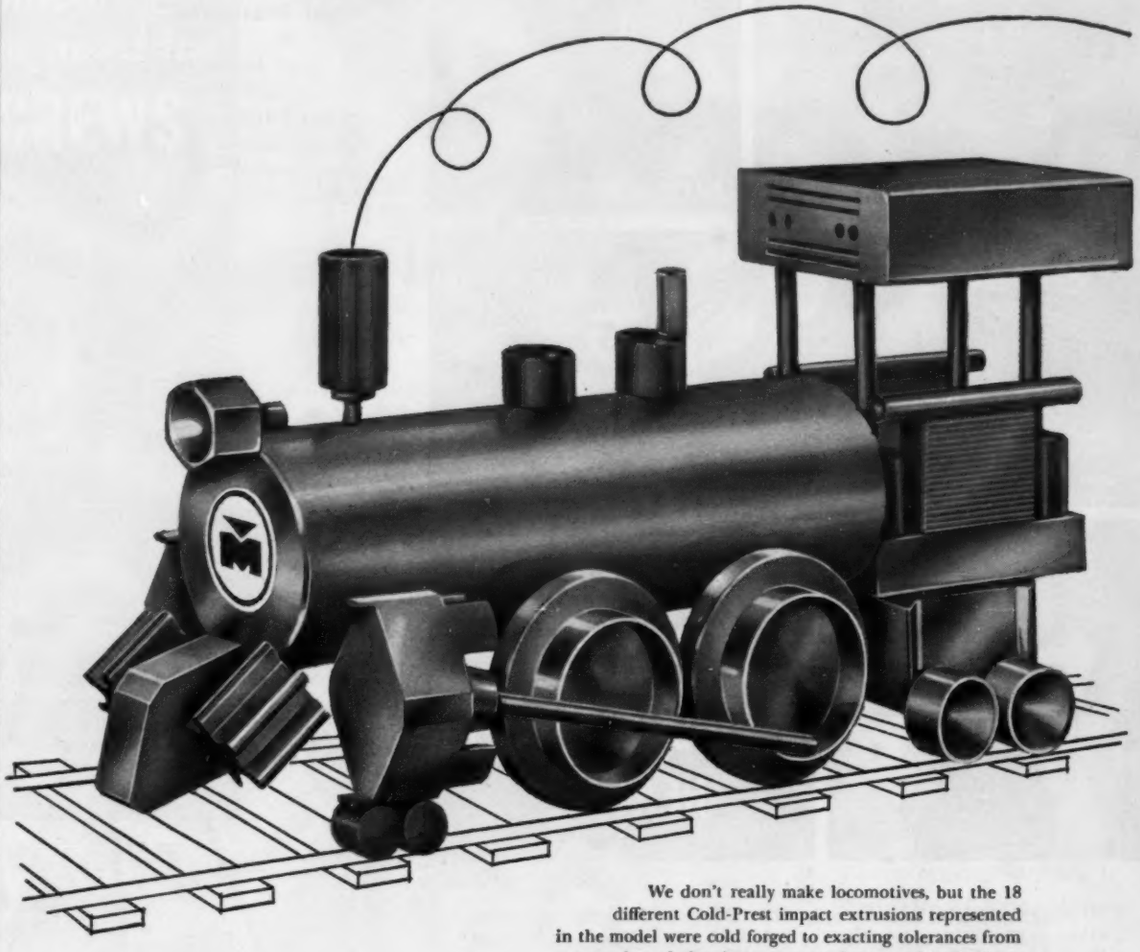
8-Inch Magnetic Brake 313



The 106 B brake utilizes the "nutcracker" principle of operation. This design assures that equal pressure is applied against the wheel by both shoes, which are self-aligning and symmetrical. Shoes fit either side, either end up. Magnet coil can be changed "on the job" without dismantling brake. This is an important feature on crane applications and other installations where maintenance is difficult. Coils are epoxy-encapsulated to seal out moisture and protect coils from rough use. The possibility of dirt interfering with magnet operation is minimized since the magnet is hinged at top with the widest part of air gap at the bottom. A single adjustment (accessible from the top) compensates for lining wear and magnet gap. A built-in indicator shows when adjustment is needed.

Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio.

MUELLER CAN MAKE MOST ANYTHING IN IMPACT EXTRUSIONS...



We don't really make locomotives, but the 18 different Cold-Prest impact extrusions represented in the model were cold forged to exacting tolerances from a number of aluminum, copper, brass, and steel alloys.

These parts are employed in products ranging from door closers to missiles. Mueller has also made important advances in the production of copper impact extrusions that are especially adaptable to electronic applications. Cold forgings are precision produced to exacting tolerances and offer the additional advantage of a better finish and appreciable metal savings.

Mueller's flexible facilities for the production of Cold-Prest Impact extrusions make practical long or short runs of simple or relatively complex shapes on an economical basis. In addition, the entire Mueller engineering staff, excellent machining, finishing and assembly facilities are readily available to you when you . . .

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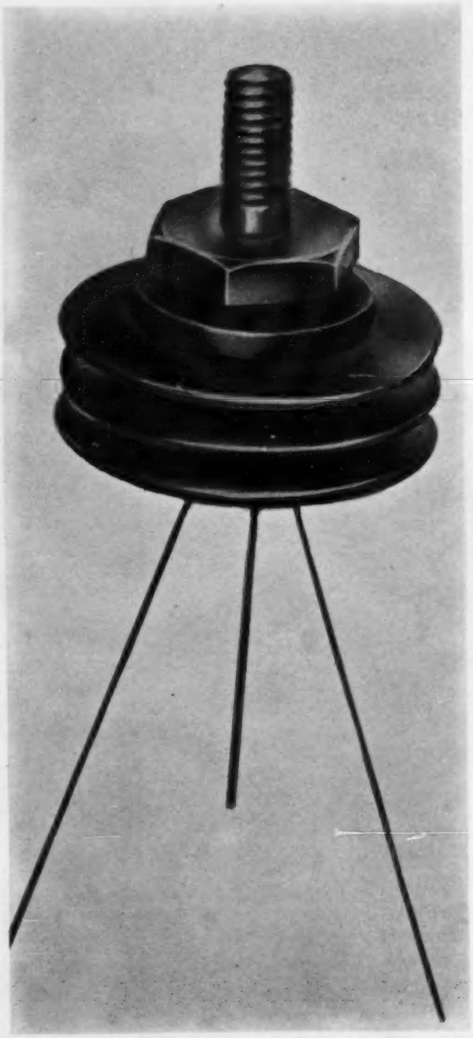
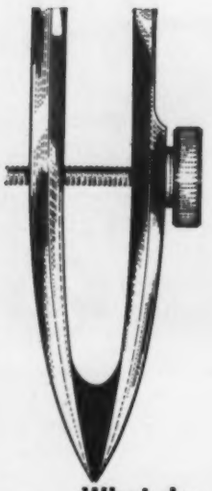
MECHANICAL

Medium-Power Heat Dissipator 314

Designed for cooling medium-powered semiconductors with JEDEC cases TO-5 and TO-9, the Model T8020 heat sink has a thermo-resistance of 16C/w. Improved tapered fins offer good efficiency and may be used for still or forced-air applications. Stud mounting assures additional heat conduction to chassis. Construction is of aluminum with dull black anodized finish. The unit is 1 inch high by 1 inch in dia and 5/8 inch from chassis. Weight is 0.31 oz. Heat sink may be modified to suit customer requirements.

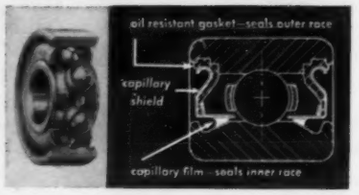
Vemaline Products Co., Franklin Lakes, N. J.





What do Bow Pens have to do with Miniature Bearings?

They help us illustrate the principle behind our famous RMB Filmoseal construction. The ink in a bow pen is held in place by capillary action—so is the oil that forms the seal in the Filmoseal bearing. This means sealing is accomplished with no rubbing mechanical contact between rotating and stationary members.
Here's how it looks:



The advantages are obvious:

A SEALED BEARING WITH—
NO RUBBING FRICTION
NO INCREASE IN TORQUE

You can specify RMB Filmoseal bearings to *low cost* ABEC 1, or 5 or 7 tolerances. Sizes available range from .1875" OD/.0550" Bore to .8661" OD/.3150" Bore. Immediate delivery. Write for complete data.

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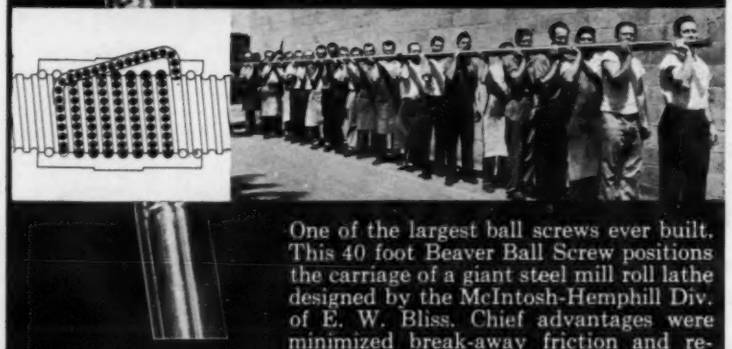
NOT THE SIZE OF THE JOB

but the demand for positioning accuracy determines the need for

BEAVER BALL SCREWS

Raytheon uses this Beaver Ball Screw in the "Hustler" search radar to actuate a delicate and extremely precise instrument control — everything else is classified, except that you can hold it between two fingers!



One of the largest ball screws ever built. This 40 foot Beaver Ball Screw positions the carriage of a giant steel mill roll lathe designed by the McIntosh-Hemphill Div. of E. W. Bliss. Chief advantages were minimized break-away friction and reduced power.

Our engineers will be glad to work with you in determining if ball screw actuation belongs in your product as opposed to hydraulics or pneumatics. Call on us.

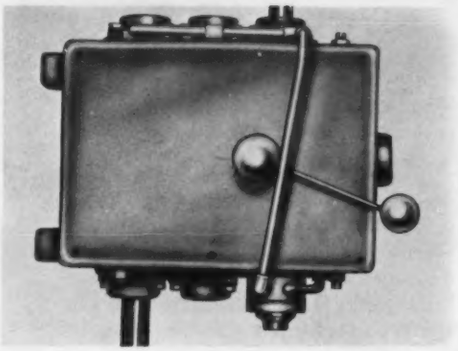
Largest manufacturers of precision ball screws

Beaver Precision Products INC.

CLAWSON, MICH.

Circle 70 on Reader-Service Card for more information

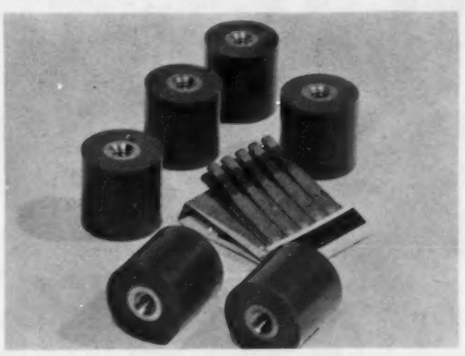
Vertical-Shaft Transmissions 315



Assembled from parts carried in stock, a line of vertical-shaft-mounted transmissions is available in eight different series, each ranging from two to nine speeds. The 2MV and 3MV series have a 1-inch-dia shaft with 1/4-inch key size and hp rating at 1750 rpm ranging up to 13 hp. The 5MV and 6MV series have 1-1/8-inch shafts with 1/4-inch keys and hp rating up to 22.5. The 10MV series has a 1-3/8-inch shaft with 3/8-inch key and rating to 51.0 hp. Series 20MV, 30MV and 50MV all have a 2-1/4-inch shaft with 1/2-inch key and hp ratings of 87, 105 and 140, respectively.

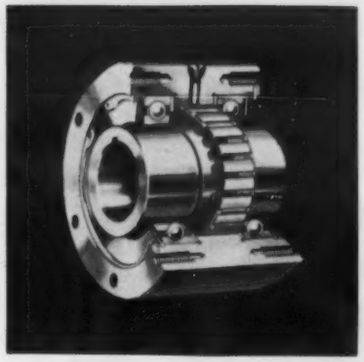
Turner Uni-Drive Co., 3416 Terrace St., Kansas City 11, Mo.

Insulating Standoff 316



Part No. 2165-1 for panel and switch boards combines flame retardance, carbon-tracking resistance and tough characteristics of fiber-glass-reinforced polyester. Designed for NEMA and UL applications of up to 600v, the standoff insulator is molded of "Resistrac", a fiberglass alumina polyester compound. The 1-inch-high, 1-inch-dia unit is molded to close dimensional tolerances. Two threaded brass inserts (1/4-20, 5/16-inch full thread) are molded in, giving a torque strength adequate to twist off a 1/4-inch machine bolt. The insulator has been tested at 5000v. Samples are available.

Glastic Corp., 4321 Glenridge Rd., Cleveland 21, Ohio.



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- More capacity for a given size and weight of clutch
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- Rated torque capacities 140 to 13,500 lbs. ft.
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FORMSPRAG COMPANY
23605 HOOVER ROAD, DEPT. 116
WARREN (DETROIT), MICHIGAN

Precision Power Transmission Products

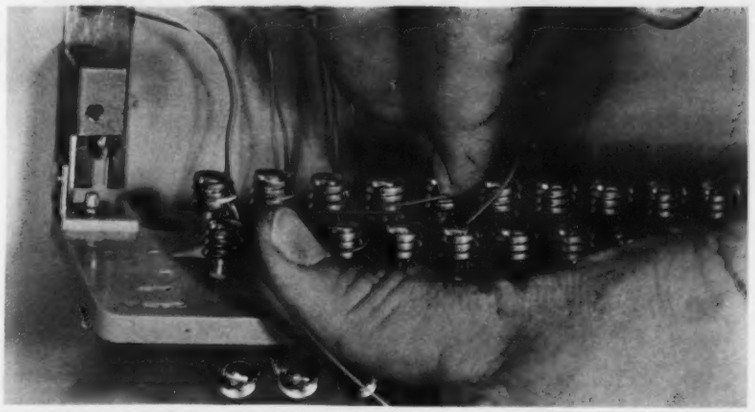
Circle 71 on Reader-Service Card

Magnetic Hold-In Switch 317

A small magnetic switch with a builtin solenoid permits electrical release from a remote location. When the toggle lever is operated and the solenoid is energized, the lever stays in the actuated position until released manually or electrically by de-energizing the solenoid. The unit is housed in an "environment-proof" enclosure filled with inert gas under pressure, providing consistent operating characteristics regardless of atmospheric pressure variations. The slender (1-inch ID) housing is suited for locations where space is limited. Turret-type terminals allow easy solder connections. DPDT switch is 28v d-c at 24-amp inrush; 4 amps resistive; 2.5 amps at sea level and 2 amps at 65,000 ft inductive; and 4 amps motor.

Micro Switch Div. of Minneapolis-Honeywell Regulator Corp., Freeport Ill.

Coil-Spring Connectors 318



Wires can be connected rapidly and without first stripping the insulation through use of this coil-spring terminal connector. The device also allows connection and disconnection without disturbing other wires connected to the same post. Spring wire is square-shaped rather than round or oval. When insulated wire is looped around the spring and pulled tight, the wire is forced between two turns of the coil. Square edges of connector bite through plastic insulation and make multiple contacts with the wire. Connector is made of tin-plated phosphor-bronze wire approximately 1/16 inch square, wound into a coil of about 3/8-inch OD. A brass post through center of coil attaches it to terminal block. Connectors have been tested in reactive environments such as hydrogen-sulfide.

Bell Telephone Laboratories, 463 West St., New York, 14, N. Y.

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SPHERICAL BEARINGS

Combine "Monoball"® Engineering Advantages with Life-Time Lubrication

Design engineers in many industries are specifying new "DYFLON"® SELF-ALIGNING and SELF-LUBRICATING SPHERICAL BEARINGS for these 5 major reasons:

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2. WITHSTAND EXTREME VIBRATION ...perfect performance under shock load conditions.
3. WILL NOT "COLD-FLOW" ...even under extreme load conditions.
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In addition, due to their two-piece "MONOBALL"® design and plastic alloy insert, "DYFLON"® bearings have a long cycle life. Alignment and installation problems are minimized. Oil-free for life means lowest possible maintenance costs.

Available in a variety of plain or rod end types. Bore sizes to 3.000". Materials include stainless steel, plastic alloys and chrome alloy steels. Ultimate static loads to 500,000 lbs.

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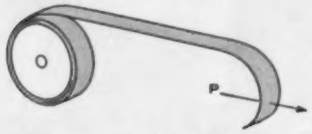
the NEG'ATOR® Data Book

HUNTER Springs in Springs

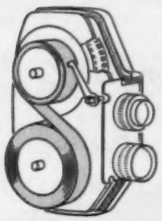
3. MECHANICAL MOTORS

Using NEG'ATOR springs to produce constant torque



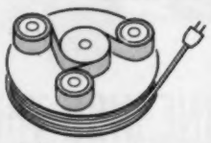
1. The NEG'ATOR spring is a strip of spring steel formed into a pre-stressed coil. It resists uncoiling with a uniform pull—provides a truly constant-force spring of practically any length.

2. By reverse winding the free end around a second, larger drum, we can utilize the tendency of the material to recurl to its preset curvature to make a powerful, long-running NEG'ATOR motor.



3. Thus, the NEG'ATOR motor releases maximum useful energy at constant-torque output from full wind to run down. Related components can be greatly simplified because there is no exaggerated torque peak.

4. In counterbalancing, very long vertical travel is possible from a compact NEG'ATOR unit concealed overhead, or even in the moving unit.



5. Reeling in long cords or retracting cable-connected loads is another NEG'ATOR function made possible by its great length, smooth action and constant-force properties.

6. As an anti-backlash device, a NEG'ATOR motor ensures immediate response without lag. Constant-torque load can be applied over slight movement or over many, many turns.

7. Six stocked models of NEG'ATOR motors are available to designers for test or assembly purposes. These models provide cable tensions of 3/8, 1, 2, 3, 4 and 5 lbs.

How to use NEG'ATOR Motors?

■ Movie cameras, valve operators, recording instruments, satellite recorders, timers, X-ray apparatus, lighting fixtures, appliance cord retrievers, and other familiar products use NEG'ATOR motors, reels and counterbalances. Write for details.

The NEG'ATOR spring is a development of Hunter Spring Company.

HUNTER SPRING COMPANY

A Division of American Machine and Metals, Inc.

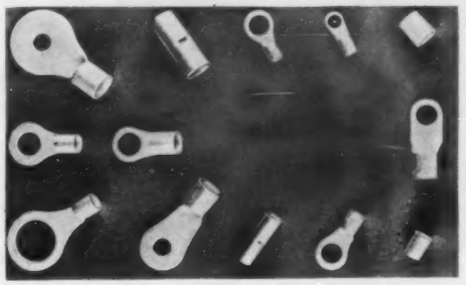
10 Spring Avenue, Lansdale, Pennsylvania

ULysses 5-6815 TWX: 982-U

DIVISIONS OF AMERICAN MACHINE AND METALS, INC.: Troy Laundry Machinery • Riehle Testing Machines • De Bothezat Fans • Tolhurst Centrifugals • Filtration Engineers • Filtration Fabrics • Niagara Filters • United States Gauge • Rahm Instruments • Lamb Electric Co. • Hunter Spring Co. • Glaser-Steers Corp.

Circle 75 on Reader-Service Card for more information

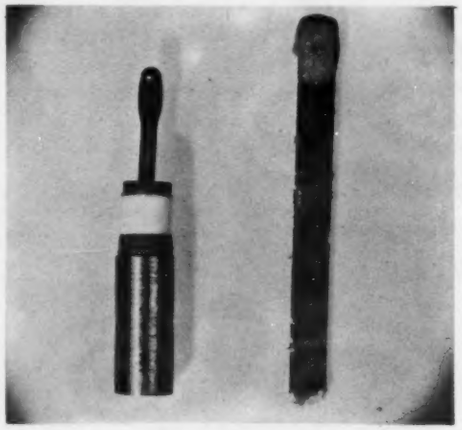
Solderless Terminals 319



Heavy-duty and large-wire-range terminals are formed from heavy stock (0.050 inch) to resist vibration that fractures standard terminals. More than 100 different sizes are offered in ring-tongue terminals and butt or parallel connectors in wire ranges No. 8, 6, 4 and 2. Stud sizes are available from No. 6 through 3/4 inch. All terminals have brazed barrels to allow crimping to wire from any part of the barrel without splitting it open. No. 8 terminals are formed from 0.050-inch stock; No. 6 from 0.057-inch stock, and Nos. 4 and 2 from full 0.075-inch stock.

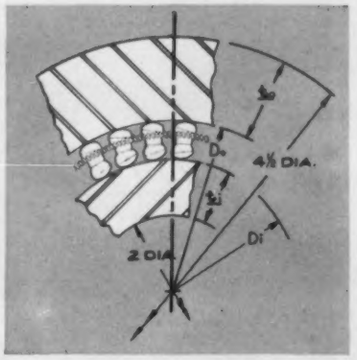
Waldom Electronics, Inc., 4625 W. 53rd St., Chicago, Ill.

Miniature Fission Counter 320



This tube measures only 1/2 inch in length and less than 1/4 inch in dia. Since the device is intended primarily for wired-in applications, solder connections may be made directly. All of the metal parts are made from titanium, providing low activation cross-section. The insulation is a high-purity ceramic. Normal operating voltage is 300v, but up to 1000v can be applied without damage to the tube. Thermal neutron sensitivity is about 10^{-3} neutrons/cm^2-sec, or 10^{-3} cps/nv. The WX-4645 unit is designed for temperatures up to 300C.

Westinghouse Electronic Tube Div., Box 284, Elmira, N. Y.



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Custom designed Formsprag clutches offer more torque for a given size and weight, higher overrunning speeds, chromium carbide alloy "Formchrome" sprags, maximum precision, as well as specific features required by the particular application.

Often, your needs may be met precisely and economically by adapting general purpose FS Series or high performance HPO (overrunning) or HPI (indexing) Series clutches. Whether the ultimate choice is a standard, modified-standard, or special clutch—top performance is assured.

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WARREN (DETROIT), MICHIGAN

Precision Power Transmission Products

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SYNTRON PARTS FEEDERS

—speed production, increase efficiency of most operations requiring continuous controlled feeding of small parts.

—flexible enough to handle a wide variety of parts—sizes, shapes materials.

—adaptable to most automatic machines. Supply parts in an oriented, single-line at rheostat controlled rates.

—dependable, powered by the world famous Syntron Electromagnetic drive unit, 3600 vibrations per minute, rheostat control, no mechanical wearing parts to replace or maintain.

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Investigate the possibilities of Syntron Parts Feeders in your parts handling operation.

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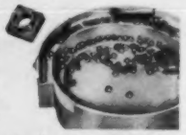

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Feeding wing nuts

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61PFI

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Rectifier Power Units

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Design News • Design News • Design News •

Lovejoy

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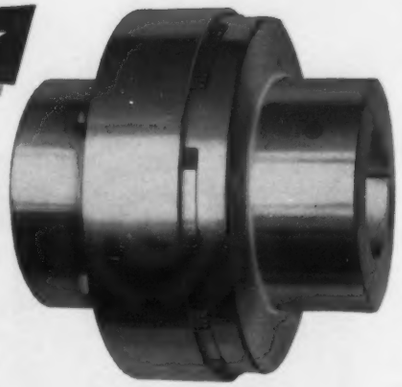

- Get stock delivery on any size or type you want—.003 to over 8500 hp. Specials made to order.
- Install them in seconds, using only a straight edge.
- No adjustments are needed. They contain no complicated mechanisms.
- Forget about lubrication—they don't need it.
- Run 'em dust, dirt, oil or water.
- Run 'em for years. The metal jaws never wear out, because the load is transmitted by service-rated cushions.
- *Just put 'em on shafts and leave 'em alone.*

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Lovejoy specializes in a full line of easily installed, maintenance-free power transmission equipment:

VARIABLE SPEED PULLEYS—¼ to 25 hp., ratios up to 4 to 1. Request Catalog B-61.

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UNIVERSAL JOINTS—for all industrial applications up to 1750 rpm., .35 to over 450 hp. Request Catalog D-61.

Motor Bases **Take-Up Frames**
Shaft Mounted Gear Reducers **Variable Speed Transmissions**

Write on your company letterhead or phone for literature and prices. If you have a specific requirement or problem ask for recommendations. No obligations.

LOVEJOY FLEXIBLE COUPLING CO.

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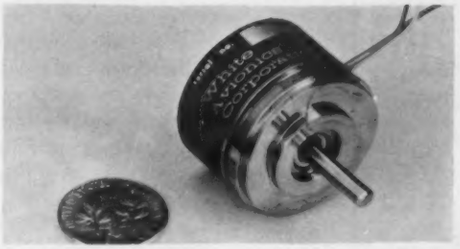
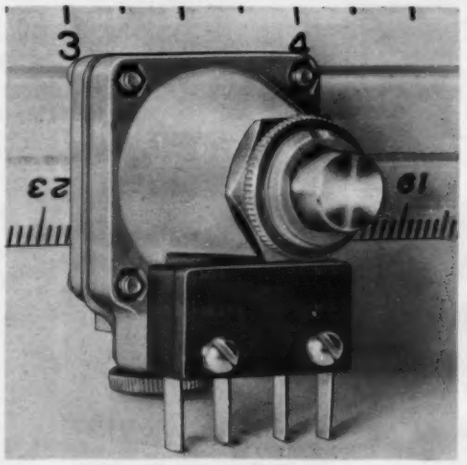
Solid-State Rotary Switch 322



Consisting of a slotted disc passing a beam of light to photosensitive diodes, this Size 11 rotary switch can be provided with any switching sequence with an angular accuracy of 0.25 deg. The device is suited for military or other severe environmental applications at temperatures to 100C. There are no wearing contacts in the SPDT switch configuration. Current capacity of 150 ma at 28v d-c permits control of relays. The switch can be used also for triggering silicon-controlled rectifiers or as a pulse generator for programming a computer system.

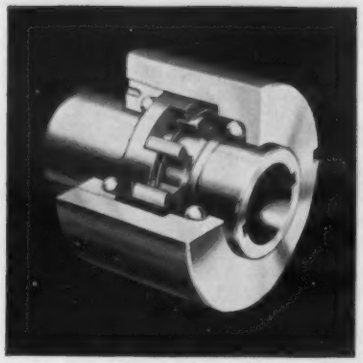
White Avionics Corp., Terminal Dr., Plainview, N. Y.

Miniature Pneumatic Timer 323



This new time-delay relay is built for 5 million actuations. Basically a flush-mounted component, the device has a universal bracket for mounting in any position. The miniature timer is only 1-1/2 inches square and weighs less than 1 oz. Time range is adjustable from 0.2 to 15 sec and the replaceable switch is rated at 10 amps. Model 90 timer will operate efficiently (within a repeat accuracy of ±10 percent) in temperatures of 32 to 120F. The unit may be used as a combination limit switch and a time-delay "limit switch".

Hagen Mfg. Co., 104 Walnut St., Baraboo, Wis.



Positive Positioning

R L

reverse lock clutches

With the R-L reverse lock clutch you can position a load precisely and be sure it will not move. The reason lies in the design that permits torque to be transmitted from the power source to the load in either a clockwise or counterclockwise direction but not from the load back to the power source.

Wide Choice of Capacities—Standard models currently available provide torque capacities from 40 lbs. in. to 30,000 lbs. in. Bores and shaft sizes range from ¼" to 2½".

Typical Applications—Examples of drives benefiting from the positive positioning feature include: radar antenna drives, timing drives, machine tool applications in which cutter bar must be accurately positioned along lead screw, etc.

Get more data by writing for Catalog RL-101.

FORMSPRAG COMPANY

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WARREN (DETROIT), MICHIGAN

Precision Power Transmission Products

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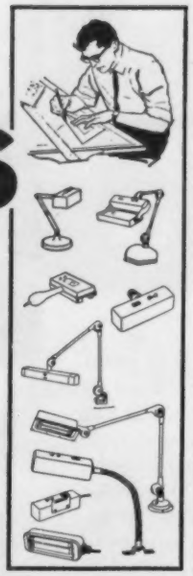
DESIGNERS' INFORMATION
about standard and CUSTOMIZED supplementary

LITES



Wherever you need a supplementary light . . . on a machine tool, instrument, test panel, business machine, sewing machine, computer, etc. . . . we can give you a light tailored to your exact design and production requirements.

Save time and money by utilizing our broad lighting experience. We'll do the lighting engineering and (at a very nominal price) will supply a working model. If you require a CUSTOMIZED light, we will design it, and, again, will supply an actual working model.

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designers

→ *moving air or materials*

Send for this

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Catalog 92 has 24 pages filled with useful information on neoprene coated fabric, wire reinforced Flexaust hose and Portovent retractable duct applicable to their use in air and materials handling, fume and dust control. Includes data on pressures, friction losses, construction, accessories, and other details essential to good design.

THE FLEXAUST COMPANY

Circle 81 on Reader-Service Card for more information

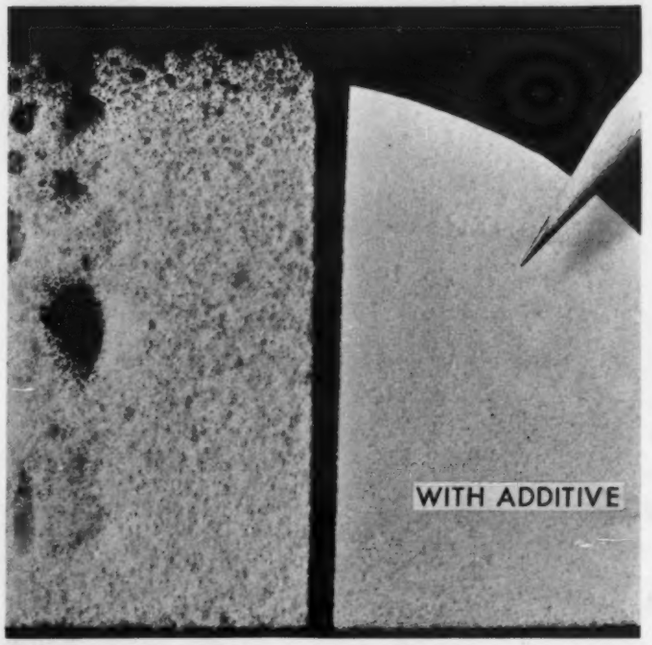
MATERIALS

Silicone Additive

324

Production of polyurethane foams has been improved through use of No. 113 silicone additive. The material offers good stability in storage either alone or in a package premix. It is less sensitive to flame retardants, viscosity and color stabilizers and to variations in mixing. Function of the silicone-glycol copolymer is to promote formation of uniform, fine-celled, rigid, polyurethane foam and help to lower costs. Easy to handle, the material is used at concentrations from 0.3 to 0.8 percent, based on total weight to produce uniform foam structures. The liquid additive is shipped in containers of 9, 45 and 450 lb net weight. Samples are offered to producers of polyurethane foam.

Dow Corning Corp., Midland, Mich.



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AT TEMPERATURES FROM −400° F TO +1500° F!

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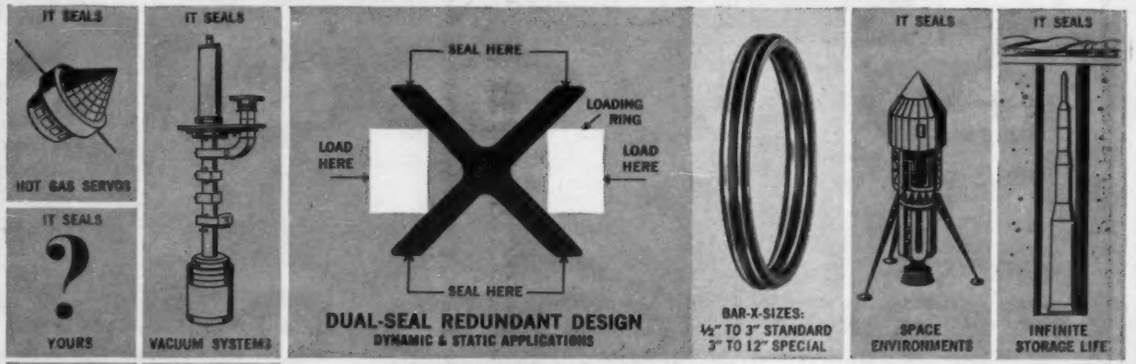
ANY SYSTEM—HYDRAULIC—PNEUMATIC—VACUUM—CRYOGENIC—NUCLEAR



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UNPRECEDENTED SERVICE LIFE

Eliminates critical downtime ■ Very high and very low pressure ■ Easy, foolproof installation (not a mechanism) ■ All-metal—non-contaminating ■ Stable, symmetrical design

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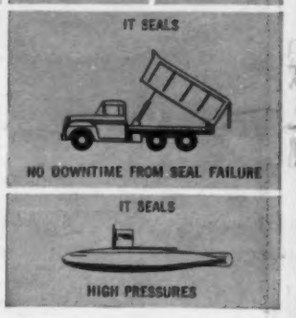

Wiggins

E. B. WIGGINS OIL TOOL CO., INC., Dept. C1
3424 E. Olympic Blvd., Los Angeles 23, Calif.
TWX 1403U, Phone AN 9-0181

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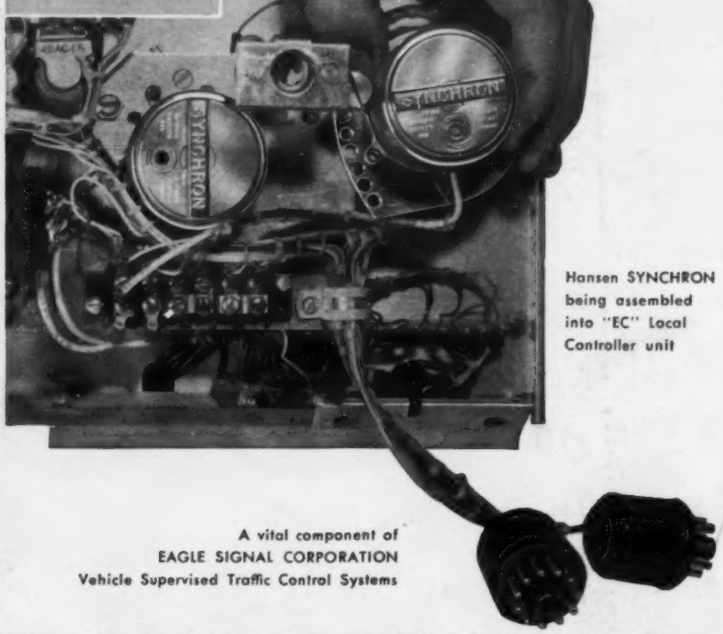
PRODUCT APPLICATION

HANSEN SYNCHRON TIMING MOTORS

TRAFFIC CONTROL systems



Hansen SYNCHRON being assembled into "EC" Local Controller unit

A vital component of
EAGLE SIGNAL CORPORATION
Vehicle Supervised Traffic Control Systems

EAGLE SIGNAL CORPORATION uses Hansen SYNCHRON motors for synchronous power to govern signal timing operations in "EC" Traffic Control Systems. Hansen SYNCHRON motors regulate amber and pedestrian clearing intervals — and all other intervals which remain *constant* regardless of cycle length . . . and also govern the 4 independent traffic splits (time division for vehicular traffic) — as well as any interval which is *variable* according to cycle length. The Hansen SYNCHRON, regulating constant intervals, operates on 60-cycle power supply . . . the one governing variable intervals responds to variable frequency from the master control unit.

HANSEN SYNCHRON TIMING MOTORS were chosen by Eagle Signal after careful testing of several makes of synchronous motors. Due to the size of some timing devices and control units, a small motor with good performance characteristics was needed to fit the space limitations. After extensive tests, Hansen SYNCHRON motors were specified for: (1) high-quality performance under test; (2) lower cost; (3) long-life operation as an integral part of traffic control units. Since adoption, Eagle Signal has never experienced an assembly slowdown or stoppage due to failure on service or delivery of Hansen SYNCHRON Timing Motors.

SEND TODAY for informative folder containing specifications and technical data on all Hansen SYNCHRON motors and clock movements.

HANSEN MANUFACTURING COMPANY, INC.
PRINCETON, INDIANA

HANSEN REPRESENTATIVES:
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H. C. JOHNSON AGENCIES, INC.
Rochester, N. Y. — Buffalo, N. Y. — Syracuse, N. Y.
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ELECTRIC MOTOR ENGINEERING, INC.
Los Angeles, Calif. — (OLive 1-3220)
Oakland, California
WINSLOW ELECTRIC CO.
New York, N.Y. — Essex, Conn. (SOuth 7-8229)
Philadelphia, Penn. Cleveland, Ohio

Sweet's Product Design File

Circle 83 on Reader-Service Card for more information

Cadmium Dip 325

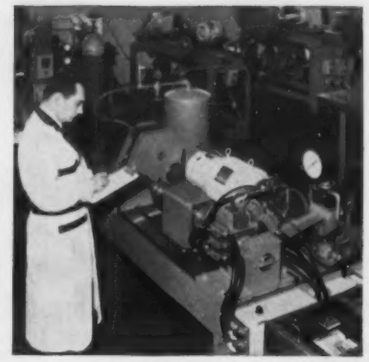
Brightening and corrosion protection of cadmium plate in a single dip is offered by "Kenvert No. 26". The material can be used for bulk treatment of cadmium in a horizontal plating barrel and will produce bright work without staining in the rinsing operation. Shelf life is lengthened and the bath operates at room temperature. No ventilation is required; dip time is from 5 to 10 sec.

Conversion Chemical Corp., Rockville, Conn.

Hydraulic Seals and Packings 326

Urethane hydraulic seals and packings have high tensile strength (over 5000 psi at break) which enables them to withstand pressures of 3000 to 10,000 psi and higher with no backup rings. A key design feature is a chamfered sealing lip. This offers several important advantages, including: immediate and leakproof sealing, even at very low pressures, and simple assembly of seal bearing components into housing without any special tools or fixtures. Seals and packings can operate efficiently over a wide variety of temperatures, ranging from −40 to 225F. They are compatible with most hydraulic fluids and offer a high abrasion, tear and wear resistance. Toughness of the material permits surface finishes of moving parts to be as coarse as 32 rms. Though the hardness of material used is 90 on the Shore A durometer scale, it has a high resilience—550 percent elongation at break. The urethane grade also has a high modulus and a low compression set. Seals and packings are available in the form of U-cups, O-rings, cup packings, flange packings, rod wipers and washers.

Disogrin Industries, Inc., Div. of Pellon Corp., 510 S. Fulton Ave., Mt. Vernon, N. Y.



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QUALITY
keeps equipment on the job

Dependability, long-life and minimum service are characteristics of every clutch (indexing, centrifugal, over-running) built by Formsprag. These factors assure peak performance:

Constant Improvement—Research, development and testing in unique, completely staffed laboratory (see photo above) maintain design leadership.

Quality Control—Exceptional manufacturing and inspection standards result in clutches that meet or exceed the most demanding military and industrial requirements.

Unexcelled Service—When service is needed, *rapid turn-around* plus rebuilding at a fraction of original cost.

Write for Catalog 105B to get the comprehensive story.

FORMSPRAG COMPANY
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WARREN (DETROIT), MICHIGAN

Precision Power Transmission Products

Circle 84 on Reader-Service Card

'Dacron'-Epoxy Tubing 327

A heat-shrinkable tubing provides simple and precise slip-ring position and eliminates close-tolerance machining operations. Tubing with a 1-inch ID shrinks 0.030 to 0.050 inch when heated to 150C for 10 minutes and allowed to cool to room temperature. Grade HY 418 has a tensile strength of 8500 psi; a compressive strength of

17,200 psi; a dielectric strength of 407v per millimeter and water absorption of 0.18 percent. ID range is from 1/4 to 48 inches and wall thicknesses range from 1/16 to 1 inch. Maximum length is approximately 36 inches.

Westinghouse Electric Corp., Micarta Div., Hampton, S. C.

Circle 85 for Reader Service

Shaping metals that shape your future

HARPER

Corrosion-resistant fasteners in all alloys

A new world of shapes heretofore impossible to obtain now extruded by

Lengths 1/8" to 60 feet! Low makeready costs! No materials waste!

Lower in-place assembly costs with a stronger product! Write, wire,

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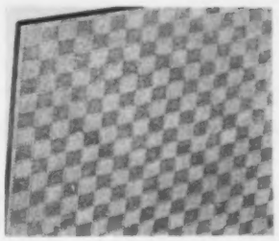
Corrosion-resistant fasteners in
alloys
H. M. Harper Company in stainless steels, carbon steels, super alloys!
Passivated finish! Exact specification adherence! Delivery to your needs!
phone! H. M. Harper Company, YO 6-6000, Morton Grove, Illinois

Embossed Hardboard 328



Used in its natural state or finished with paint or lacquer, this decorative board finds use in wall and ceiling paneling, enclosures and screens, table tops or cabinets. The tough, durable pattern is embossed and tempered. Panels are offered in sizes of 4 by 8 ft and in thicknesses of 1/8 and 1/4 inch. Samples may be obtained on request.

Hardboard Fabricators Corp., Newark, N. J.

Self-Adhering Tags 329

Labeling without the use of stringed or wired tags is accomplished with this system. The reverse side of the tag utilizes a stripe of self-adhering material for wrap-around labeling. The results are improved efficiency and reduction in cost. For in-plant labeling, a coupon system is available.

Dennison Mfg. Co., Framingham, Mass.

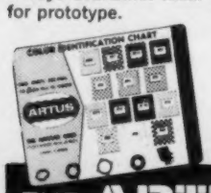
Circle 85 for Reader-Service

NEW THE COLOR TELLS THE THICKNESS

ARTUS 100 SHIMS THIS SIZE

Send blueprint for shape required. Special tooling, first order only $9.75.

Real time savers in production and maintenance. Used by thousands including America's best known companies. More efficient, more convenient. Always available. Ideal for prototype.



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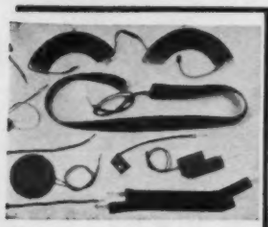
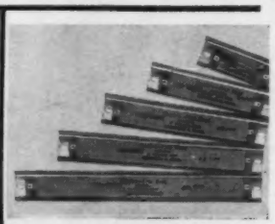
STANDARD HEATING ELEMENTS ANY SIZE—ANY SHAPE

ECONOMICAL POWER RESISTORS FOR FLIGHT USE



Light-weight, tough, flexible. Operate under high pneumatic pressure. Resist corrosion. Immersible. Insulated with silicone rubber or neoprene. Meet USAF specifications.

If you have a special heating problem let us solve it for you.



New lightweight, space-saving resistors permit substantial efficiencies and economies in aircraft and missile electronic apparatus. Units are mounted in direct contact with inner surface of chassis or case so that 25% to 40% of heat generated is emitted to atmosphere. Derating curves are available.

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Electro-Flex Heat, INC.
83 WOODBINE ST., HARTFORD, CONN. (CHapel 6-5413)

"FIRST with STANDARD ELEMENTS"

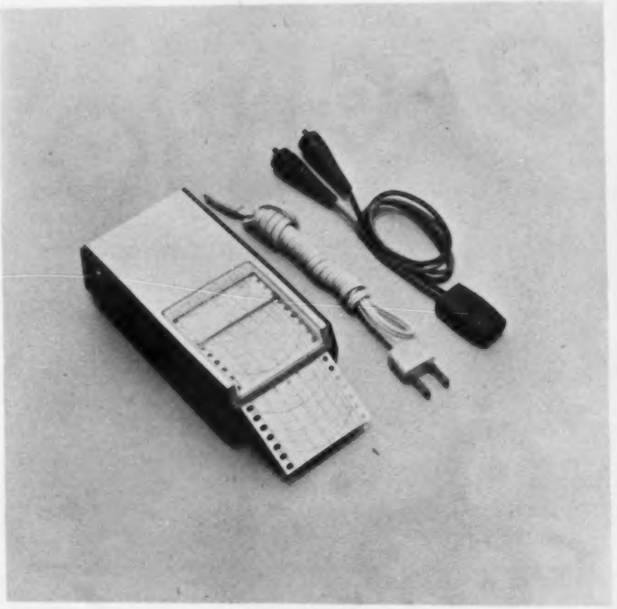
Circle 87 on Reader-Service Card for more information

Miniature Recording Voltmeter

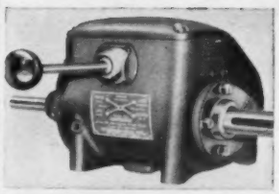
330

Measuring only 3-1/16 by 5-5/8 by 1-11/16 inches, this portable meter is rugged, sensitive and simple to operate. A legible, permanent record is made on smudgeless pressure-sensitive paper tape 2-1/2 inches wide by 35 ft long. The paper is unaffected by heat, cold, moisture, humidity or fumes; it feeds at a speed of 12 inches per hr. The internal-core meter movement, motor and chart-drive mechanism are protected by "Mylar" against dust, even when paper roll is being changed. The recorder's few moving parts are encased in a sturdy housing with brushed stainless-steel lid. Two models are offered: with regular scale of 0-150, 0-300, 0-600v a-c, or with expanded scale of 95-130, 190-260v a-c (for increased accuracy). The precision recording unit weighs only 20 oz.

Amprobe Instrument Corp., 630 Merrick Rd., Lynbrook, N. Y.



TRANSMISSIONS *featuring* Electro-Magnetic Control



9000-B (1-10 H. P.)
TORQUE RATING: 1400 pound inches output, 350 pound inches input
HORSEPOWER RATING: 5 H.P., 900 r.p.m. input; 10 H.P., 1800 r.p.m input
GEAR RATIOS: 1:1 —2:1—3.14:1—4:1 Special ratios at extra cost. Maximum Reduction 5.07:1

8100-B (10-20 H. P.)
TORQUE RATING: 700 pound inches input, 2800 pound inches output
HORSEPOWER RATING: 10 H.P., 900 r.p.m input; 20 H.P., 1800 r.p.m input
GEAR RATIOS: 1:1—2:1—3:1—4:1 Special ratios at extra cost. Maximum Reduction 6.69:1

14800 (left)—Four special speed changes up to limit of case 10:1
14900 (left)—Four speed changes in geometric progression at 1.71 (total reduction of 5.03)
TORQUE RATING: 1400 pound inches input, 7500 pound inches output
HORSEPOWER RATING: 20 H.P., 900 r.p.m. input; 40 H.P., 1800 r.p.m. input

. . . for industrial and agricultural machinery, automotive trucks, tractors, refuelers, industrial shovels, cranes, shop and lift trucks, concrete mixers, road builders, diamond drills, machine tools . . .

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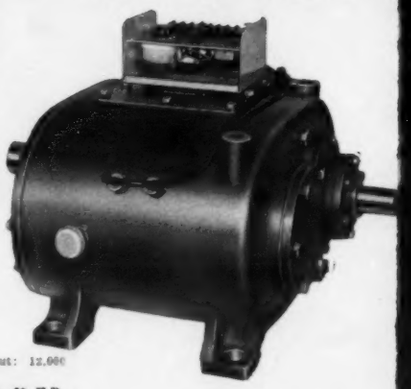

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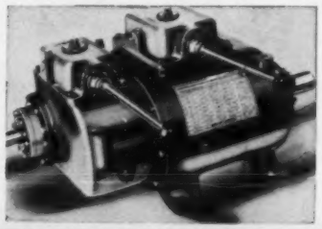

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Vapor Heating Corp., 6444 W. Howard St., Chicago 48, Ill.

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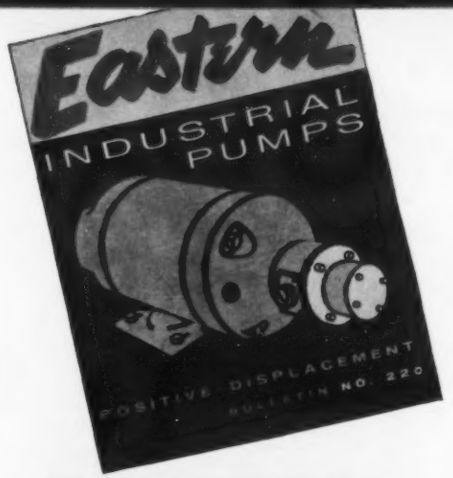

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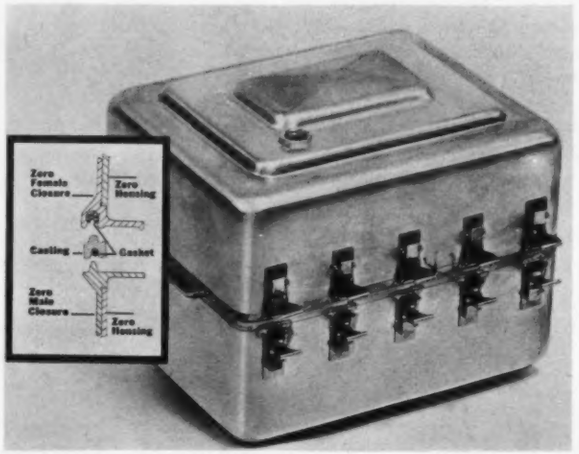

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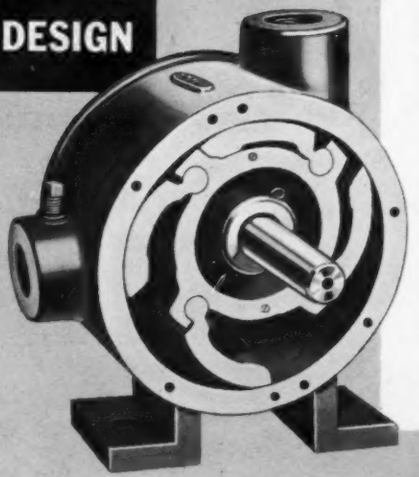

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potentiometers form a Wheatstone bridge—the meter connected indicates bridge balance. Absolute resistance value of the unit under test is not necessary and, should voltage supply be low, accuracy is not affected. Vernier dial can be read directly to one part in one thousand with the meter at null balance.

Humphrey, Inc., 2805 Canon St., San Diego, Calif.

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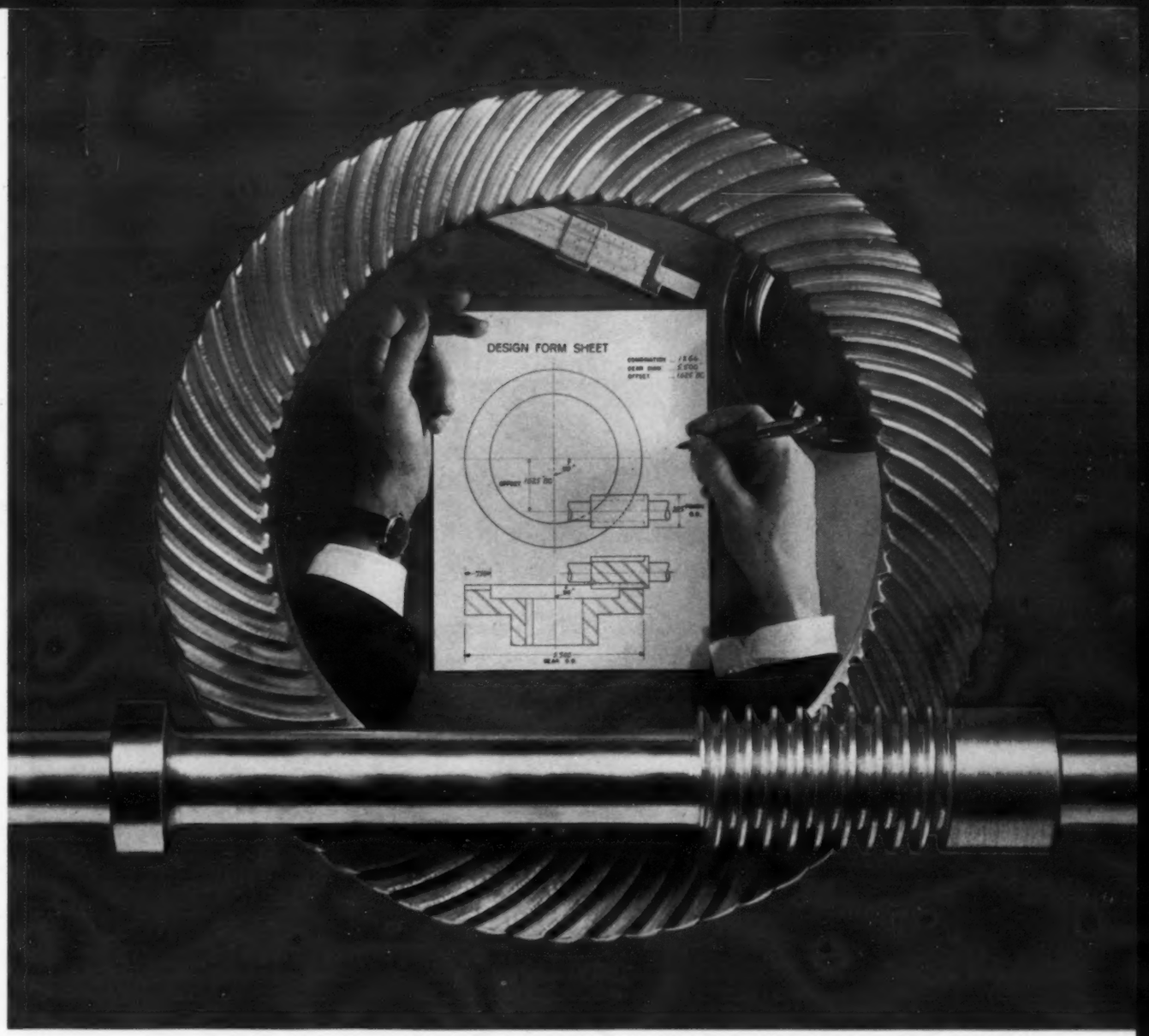

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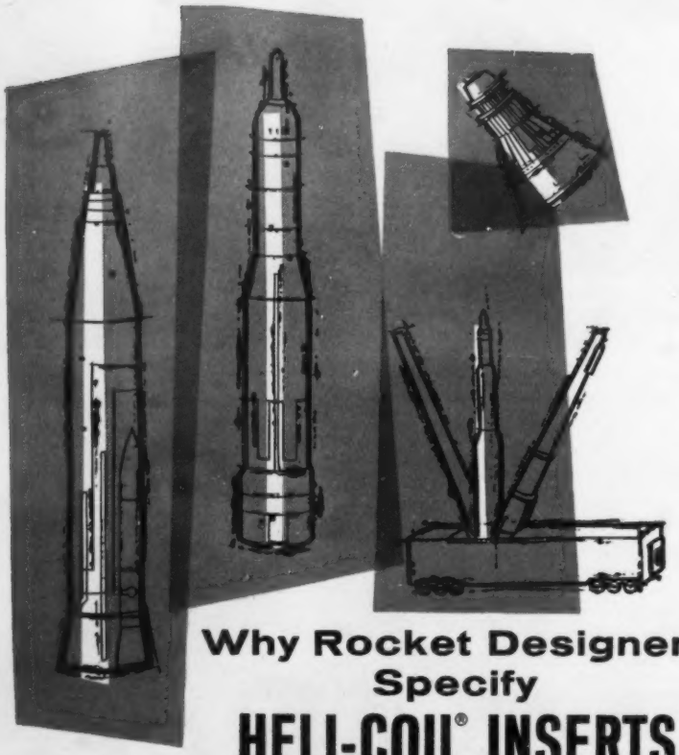

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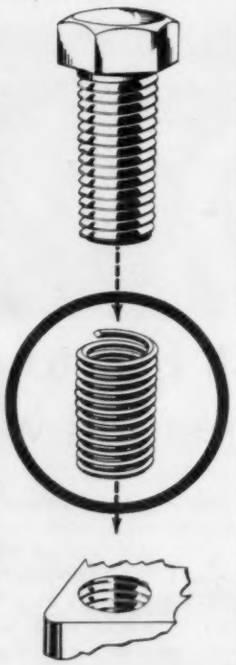

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EQUIPMENT

Portable Engine-Generator 334

Model C 869-3T is designed for field use or for normal working areas that require a portable unit. The engine-generator is rated at 300w, 115v, 60 cycle, 1 phase—yet it measures only 15 by 15 by 11 inches. The generating plant is suited for use as an alternator to reduce the number of moving parts, decreasing poundage to a minimum. Rated at 3600 rpm, the Clinton gasoline engine is lubricated by a pressure vapor oil system. The engine has an adjustable pneumatic governor and is a two-cycle, one-cylinder unit. Parts are moisture- and dustproof and bearings are of large-surface bronze. Total weight of the device is 40 lb.

AGA Corp. of America, Box 447, South Plainfield, N. J.

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Electronics & Instrumentation Div., Baldwin-Lima-Hamilton Corp., 42 Fourth Ave., Waltham 54, Mass.

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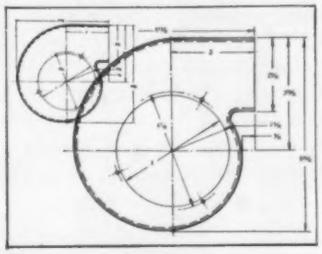

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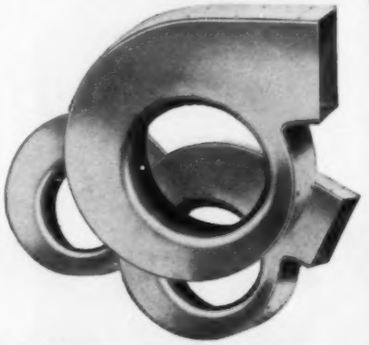

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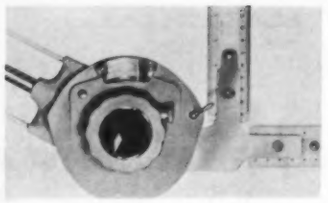
Drafting Machine 336



Incorporated in this drafting unit are a totally enclosed protractor and a new magnifier lens, providing accurate readings. New setting lock allows rapid and easy setting of positive base line. The magnifier rotates with the vernier through 360 deg and setting accuracy of 1 minute is possible through lens. Mechanism of the unit is accessible from front of the board. A second mechanism is installed in the drafting elbow, and appropriate adjustment of these two devices allows the board to be tilted up to 25 deg. Touch button controls angle selection, and arms may be lifted without disturbing machine alignment. "Scalock" device holds scales and straightedges in alignment and a leveling unit is included.

Charles Bruning Co., Inc., Mt. Prospect, Ill.

Magnetic Indicators 337

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NEW

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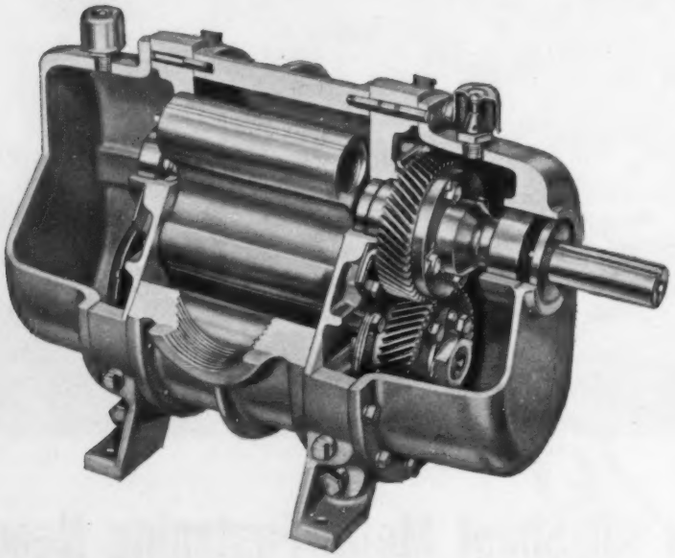

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Flexible Mold Sharply Reduces Cost

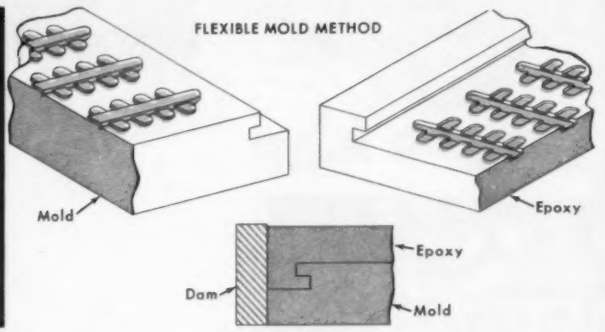
Victor W. Wigotsky, Eastern Editor

A flexible mold, made from room-temperature vulcanizing silicone rubber, results in great cost savings in the production of pellet holders. The overall cost for 24 units, using the flexible mold method, is $176. This compares with a cost of $4,876.80 if the original method were used.

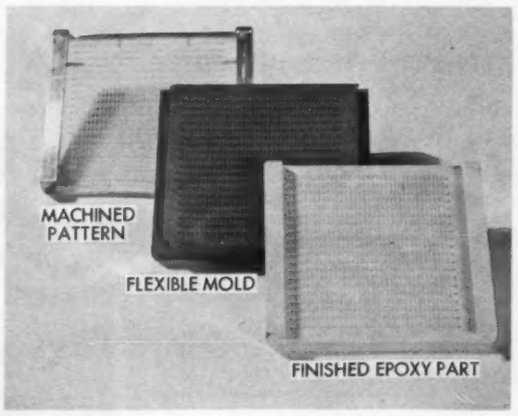
The flexible mold material, which is poured into a pattern at room temperature, maintains close tolerances and provides the flexibility necessary to remove a part containing undercuts. These characteristics resulted in the choice of molding the pellet holder with an epoxy resin, using the silicone-rubber mold, rather than machining it.

A Shop Order was originally received to machine one pellet holder consisting of clear plastic plate, 3/8 inch thick by 5-1/2 inches square. The machining required 700 milled pockets (0.078 plus 0.003, minus 0.000 by 0.020 plus-or-minus 0.001 inch). These were equally spaced in rows 0.125 by 0.250 inch. Grooves which measured 0.030 by 0.032 by 4-9/16 inches were milled horizontally through each pocket. An aluminum rail was machined and fastened to the plastic with screws on two sides. The above procedure cost $203.20 per unit.

Twenty-four more pellet holders then were required. A suggestion was made to mold them with epoxy resin, using the machined plastic pellet holder as a pattern to form a flexible mold with the



LIQUID SILICONE RUBBER is poured into master pattern (in this case, machined plastic and aluminum pellet holder). When cured at room temperature, silicone rubber becomes master pattern in form of flexible mold, which assures precision reproduction. Pellet holder then is molded as single part completely of epoxy resin. There is no need of machining rails, as in original fabrication method, since rail configuration is included in cast epoxy part. Dams are placed around mold to prevent uncured epoxy from flowing away during pouring. Finished part then is easily removed because of flexibility of mold material.

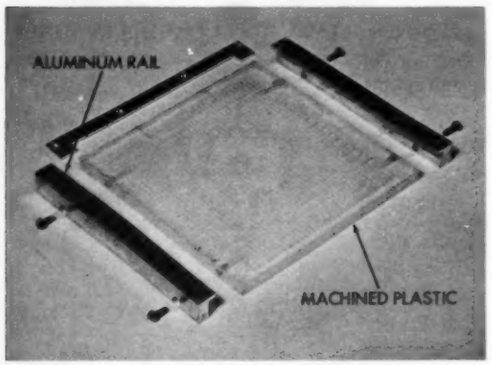


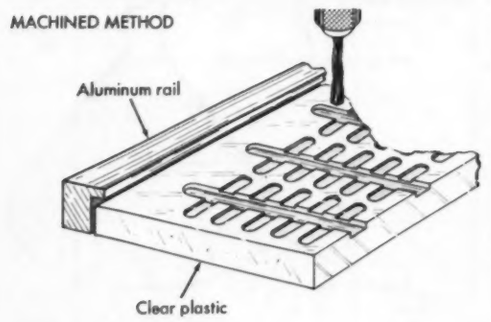
of Precision Part

room-temperature vulcanizing silicone rubber. Mold flexibility permits easy removal of the rigid epoxy-resin part. Need for a two-piece mold, which would be required with other mold materials, is eliminated.

Total cost for 24 units would have been $4876.80 using the original method. Instead, the entire job was done at a cost of $50 for silicone rubber, $24 for epoxy resin, $102 for labor, resulting in a total of $176.

The pellet holders, using the RTV silicone-rubber flexible mold material, were designed and manufactured at the Semiconductor Products Dept., Electronic Components Div., General Electric Co., Syracuse, N. Y. RTV silicone rubber is manufactured by G.E.'s Silicone Products Dept., Waterford, N. Y.





HOLDERS are used for conveyance and testing of pellets. Original pellet holder, using conventional machining methods, had to be fabricated in separate elements. Each pocket and groove was machined. Aluminum rails were then machined and fastened to clear plastic with screws.

Gasket engineering

BOLT LENGTH VS. TORQUE RETENTION

Bolt length and bolt torque are important factors in maintaining flange loads on gasketed joints. New engineering studies show the extent of these effects to be greater than anticipated.

E. M. SMOLEY
Research Physicist
Armstrong Research and Development Center

Retention of bolt torque on gasketed joints is a function of several factors. Two important ones concern the bolt itself: its length and the amount of torque initially applied to it when the joint is tightened.

Recent tests were conducted at the Armstrong Research and Development Center to study (1) the relation of bolt length to torque retention; and (2) how torque retention is affected by variations in the amount of torque originally applied to the bolts.

In these tests, separate steel flanges were prepared to accommodate three different bolt lengths—½", 1", and 1½". (See Figure 1 for definition of bolt length.)

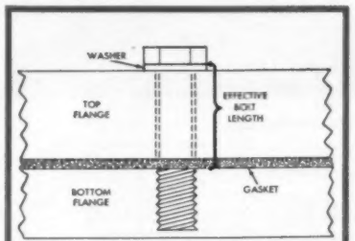


Figure 1. Here bolt length is defined as the distance from the underside of the bolt head to the face of the opposing flange—including the washer and the compressed gasket thickness.

The flanges were gasketed with an Armstrong beater-saturated asbestos material—Accopac AN-890—in 1/32" gauge. (Previous tests had indicated that this material possessed excellent torque retention characteristics.) The only variables in the tests were bolt length and initial torque values.

After the bolts were torqued to specific loads at room temperature, the flanges were placed in an oven at 300° F. for a period of 18 hours. Then they were removed, and while the flanges were still hot, bolt torque was re-measured. The percentage of retained torque was calculated and charted as shown in Figure 2.

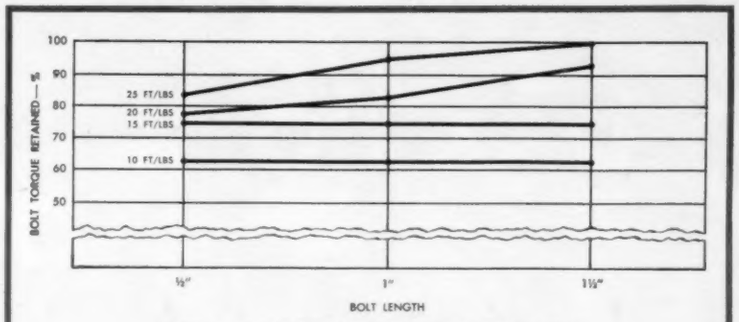


Figure 2. Curves show % of initial torque retained after 18 hours at 300° F. Initial torque is indicated at the beginning of each curve. 5/16-24 NF hard steel bolts were used.

The chart shows clearly that low initial torque loads lose proportionately more torque than higher loads. At 10 ft-lbs of initial torque, for example, the average torque loss for the three bolt sizes was 37%. But at 25 ft-lbs of initial torque, the average loss was only about 8%.

The tests also indicate that longer bolts retain torque much better than short bolts . . . and the difference is greater as initial torque is increased.

These results are, of course, what was anticipated in quality. In quantity, however, the difference in torque retention resulting from variations in bolt length and initial torque values was significantly larger than had been expected.

Research on gasket performance is a continuing project at the Armstrong Research and Development Center. Our large library of data may already contain the answer to specific problems you may have on gasket design, performance, or selection. We will be glad to make suggestions if you will submit details to us. Address inquiries to Armstrong Cork Company, Industrial Division, 6507 Ithaca Street, Lancaster, Pennsylvania.

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For additional information write for Centralab catalog 42-221 or consult Sweet's Product Design File (Folio 4a/ce).

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2. **Pump Idler Gear:** 95% alumina machined to ± .0005". Gears up to 3" diam. available. For pumping corrosive liquids.

3. **Jet Fuel Pump Piston and Sleeve:** Steatite machined with clearance of .0005" between sleeve and piston over entire length.

4. **Valve Spigot** 95% alumina polished to 3—5 helium light bands, outlasts nickel-chrome alloy 5 to 1.

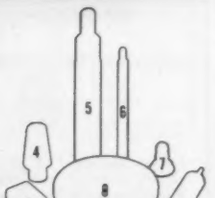
5-6. **Pump Plungers:** Surface finish of 16 micro inches. Available up to 18" long, 4" diam., not including metal attachments.

7. **Valve Seat:** Outwears hard rubber 10 to 1. Machined before firing in one operation.

8. **Antenna Insulator:** Highly glazed steatite for high voltage use. Metal attachment has bond strength of 8000 psi.

9. **Condenser Shaft:** Concentricity is ±.001 T.I.R. over entire length. Provides dimensional stability over a wide temperature range.

10. **Contact Rotor Assembly:** 85% alumina arm with precision rotor. Used to eliminate flashover and electrical breakdown.



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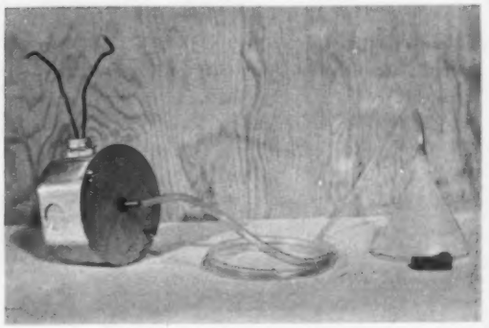
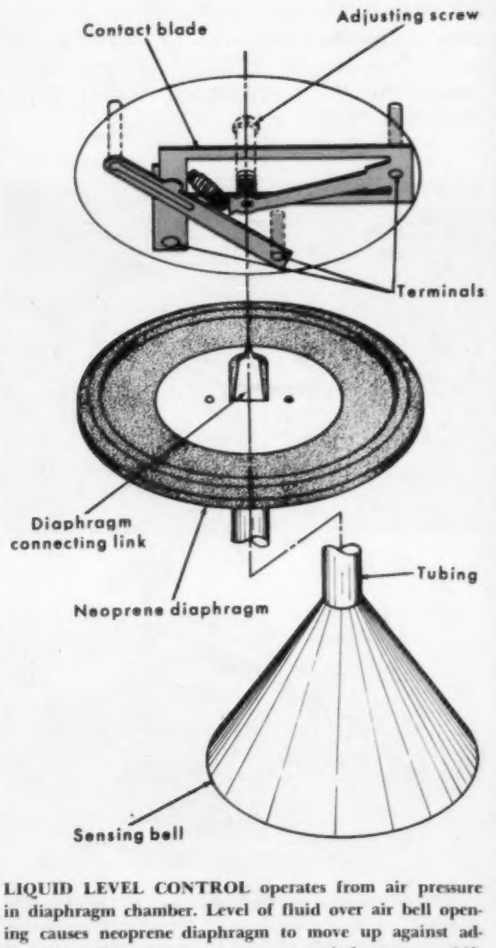
Economical Liquid Level Control

Lars G. Soderholm, Midwest Editor





LIQUID LEVEL CONTROL operates from air pressure in diaphragm chamber. Level of fluid over air bell opening causes neoprene diaphragm to move up against adjustable spring. At preset pressure, switch contacts shift and, according to manner of connection, either open or close circuit.

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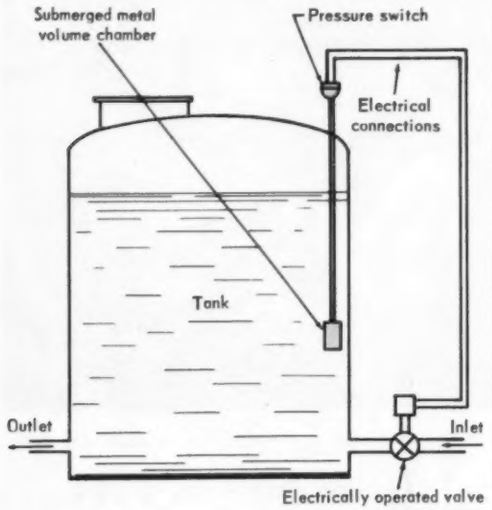
A liquid level control uses a diaphragm-actuated electrical switch connected to a sensing bell located in or near the fluid whose level is to be controlled. It consists of only three components: a sensing bell capable of holding a large volume of air, interconnecting tubing and an air diaphragm-actuated switch that can be wired to open or close in response to pressure in the diaphragm chamber. The sensing bell is mounted permanently in the vessel or pipe where the level is to be controlled and as liquid covers the opening of the sensing bell, the air is forced back through the tubing and into the switch diaphragm chamber.

The pressure switch diaphragm is opposed in its travel by a spring that permits a preloading when necessary. This allows a controlled depth of fluid to cover the air bell before the switch is actuated. This would normally be up to 60 inches of water. By keeping the air bell constantly submerged, unfavorable surface conditions of the fluid often can be avoided.

The pressure switch is rated at 15 amps for 125v a-c or 10 amps for 250v a-c. The neoprene diaphragm is operated by approximately 13 cc of air.

The polyethylene funnel-type air bell and polyethylene tubing can be replaced with metal components where necessary.

The automatic liquid level control is made by the Kata Mfg. & Filtering Co., Villa Park, Ill.



APPLICATION OF SUBMERGED SENSING BELL

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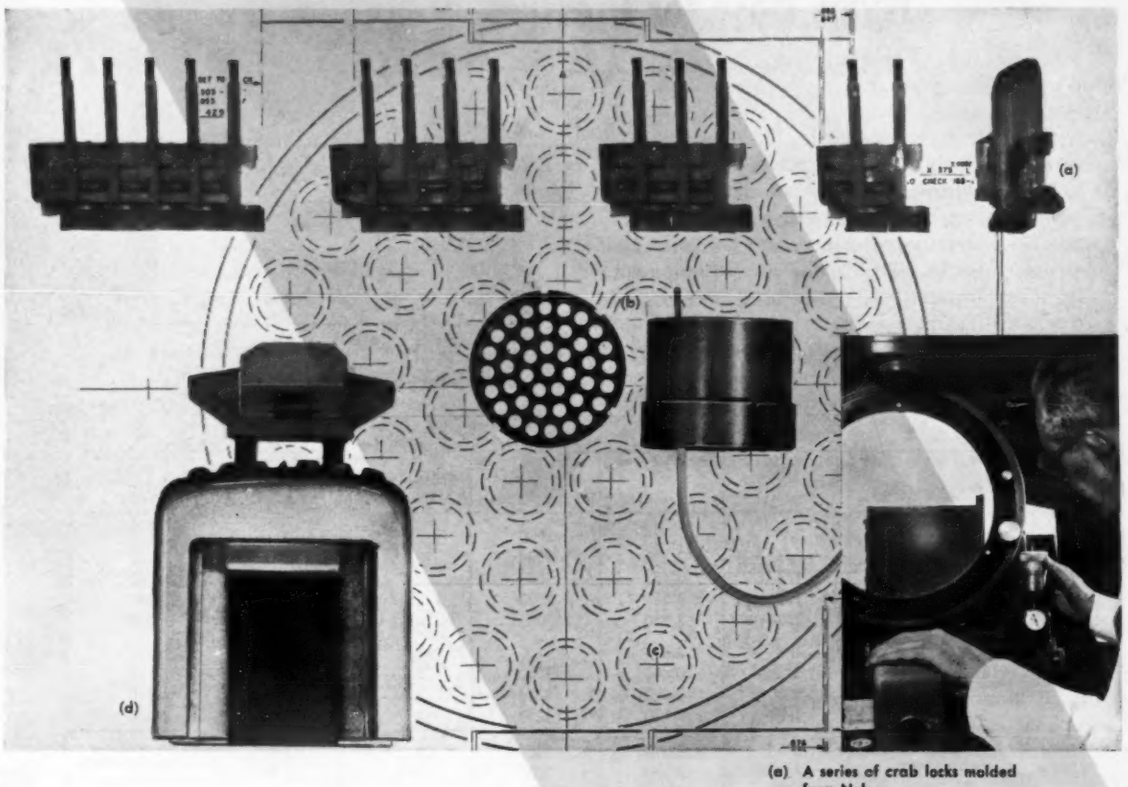

(a) A series of crab locks molded from Nylon.
(b) Electrical connectors for making and breaking as many as 41 electrical circuits at one time are used in missile tracking equipment.
(c) Comparator chart in background enlarges connectors 10 times and checks the accuracy of all holes and insets.
(d) Pick-up head for stereophonic record player. This is a complicated but very small part (one third the width shown) in which three insets are molded into the head.

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DESIGN DATA NEWS

Nylon Hose for Pressure Applications

R. B. Koch, Technical Service Engineer, The Polymer Corp., Reading, Pa.

Nylon hose is being utilized successfully in a variety of high-pressure applications, including hydraulic systems on heavy construction equipment and machine tools; high-pressure lubrication lines on heavy machinery and hot paint and solvent lines in airless paint spray equipment. In these applications, nylon hose performance compares favorably with reinforced rubber and TFE hose and, in many instances, has proved more economical than conventional flexible pressure hose. When selecting flexible hose, the designer has to consider four major factors—physical properties, chemical resistance, thermal characteristics and cost.

Application Areas

Nylon hose is available with maximum burst strengths up to 8000 psi and maximum working pressures as high as 2000 psi. These figures place it in the same general application area as rubber hose with single-wire reinforcement braid. With few exceptions, nylon hose is suitable wherever

TABLE 1	ID (inches)	OD (inches)	WORKING PRESSURE (psi)	MINIMUM BEND RADIUS (inches)	WEIGHT (lb/100 ft)	COIL LENGTH (ft)
NYLON HOSE	1/8	0.235	2000	1.75	1.6	500
	3/16	0.335	2000	2.25	2.9	500
8000 psi minimum burst strength	1/4	0.455	2000	2.5	4.8	250
	3/8	0.585	2000	3.5	8.0	200
	1/2	0.820	2000	4.5	16.6	200
	1/4	0.415	1250	2.5	3.5	500
	5/16	0.460	1250	3.0	4.3	500
5000 psi minimum burst strength	3/8	0.560	1250	3.5	6.6	250
	1/2	0.710	1250	4.5	10.2	200
TYPICAL RUBBER HOSE	3/16	33/64	3000	2.75	14.9	Approximately 60 ft lengths
	1/4	37/64	3000	3.25	18.4	
	5/16	43/64	2250	3.75	22.8	
Single wire reinforced	13/32	49/64	2000	4.625	25.9	
	1/2	59/64	1750	5.5	38.0	
TFE	3/16	5/16	1000	2.0	6.5	300 to 50 ft lengths depending on hose size
	1/4	3/8	1000	3.0	8.5	
	5/16	7/16	1000	4.0	11.4	
Stainless steel wire braid cover	13/32	9/16	1000	4.625	15.0	
	1/2	21/32	1000	5.5	18.8	

TABLE 2 — FLEX-IMPULSE TESTING ON NYLON HOSE*

Hose Number*	Nominal ID (inches)	Rated max. Operating Pressure (psi)	FLEXING CONDITIONS: Flexing Frequency (cycles/minute)	Minimum Flexing Radius (inches)	Flexing Stroke (inches)	IMPULSE CONDITIONS: Impulse Pressure Operating (psi)	Time Pressure Applied (seconds)	Time Pressure Removed (seconds)	Flexing Cycles to Failure (X 1000) Range	Impulse Cycles to Failure (X 1000) Range
503-A	3/16	1250	60	2	10	1800	1.0	1.0	800-1000	400-500
504-A	1/4	1250	60	3	10	2000	6.1	6.1	1220-1342	100-110
504-A	1/4	1250	60	3	10	2500	6.1	6.1	1171	96
504-A	1/4	1250	60	3	10	3000	6.1	3.1	671-754	73-82
504-A	1/4	1250	60	3	10	3500	8.1	1.1	101-239	11-26
505-A	5/16	1250	60	3	10	1800	1.0	1.0	620	310

* "Nylaflow" hose: The Polymer Corporation (6 samples per test – 24 inch specimens)

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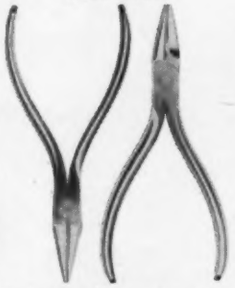

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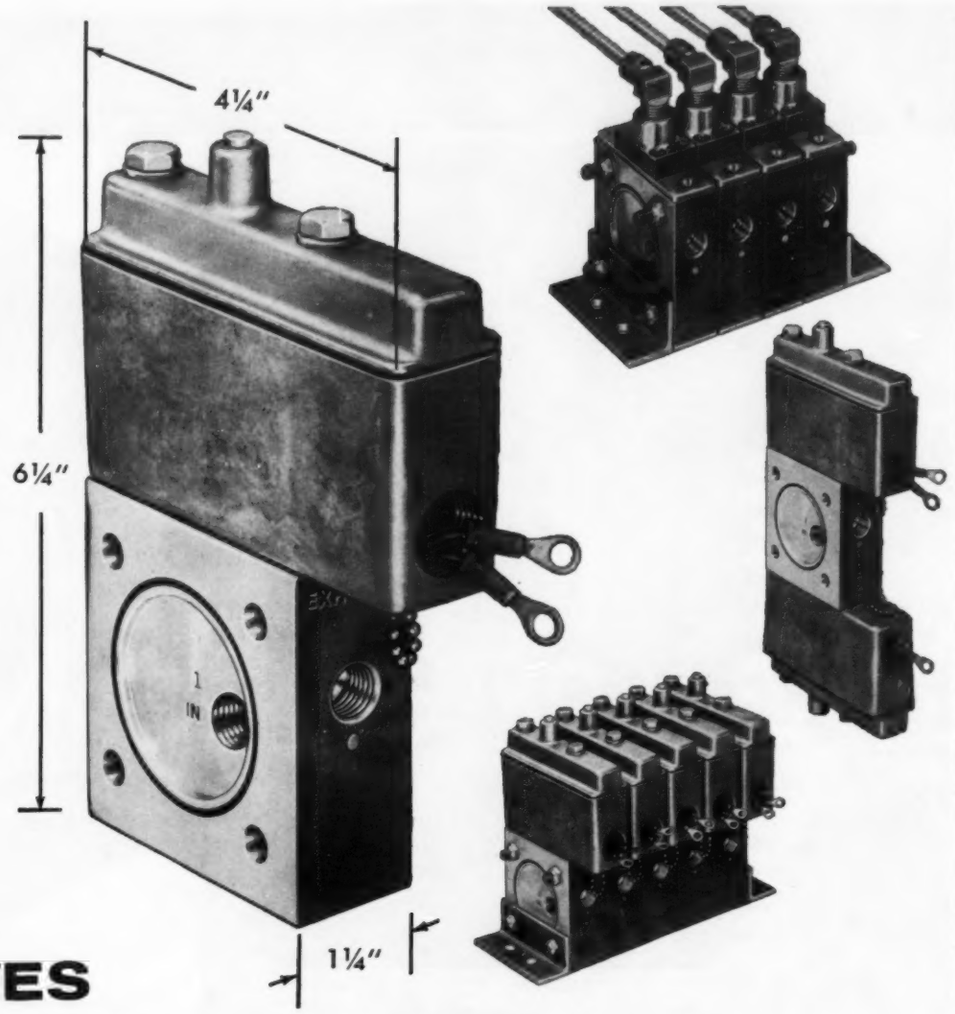

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any of the standard rubber formulations could be used. When rubber hose is considered, however, the designer must know whether to use butyl, buna-n, GR-S or neoprene according to ambient conditions or fluid to be used.

Physical Considerations

The high tensile strength of nylon provides the inner tube with high burst pressures per unit weight. Reinforcing with high tensile strength yarn produces a hose with high pressure rating and small OD/ID ratio. Wall thicknesses are approximately 45 percent of rubber hose with equivalent burst strength. These physical factors combine to produce a lightweight hose approximately 1/5 the weight of equivalent rubber hose (see Table 1).

Of greatest significance in evaluating use of nylon hose for hydraulic and lubricating systems is its operating life when subjected to pressure and flexing. Nylon reinforcement braid flexes freely with the inner tube. This construction provides long life under combined flexing and pressure impulsing (see Table 2).

Minimum bend radii of nylon hose can be less for a hose of comparable capacity (ID) because OD's are from 20 to 50 percent smaller than the OD of comparable hose. In addition, nylon hose can be permanently heat formed to still smaller stress-free bend radii.

Permanent forming is particularly applicable in lubrication systems where the bulk of other hose frequently results in excessively long lines. Permanently formed nylon hose has the added advantage of maintaining its inherent flexibility.

Light weight can be important to reduce operator fatigue with manual spraying equipment or hydraulic hand tools. For example, lines for a hydraulically operated crimping tool for use on high-tension cables weighed 15 lb. Nylon hose for this application weighs only 1.5 lb—a 90 percent savings in weight. One-hundred feet of 0.5-inch OD hose with a maximum burst strength of 5000 psi weighs only 8 lb.

Frequently, a designer needs to transmit only a small volume of fluid. The smallest commercially available steel reinforced rubber hose is 3/16 inch ID. Nylon hose is available in 1/8 inch ID with 2000 psi working pressure. Small ID, small OD/ID ratio, tighter bends—both cold and heat formed—all contribute to more compact and less expensive hydraulic designs.

Reduction in OD/ID ratio also means that smaller, less expensive fittings may be used. Another important cost consideration is the lengths of coils available. Because of the nature of man-

(Continued on next page)

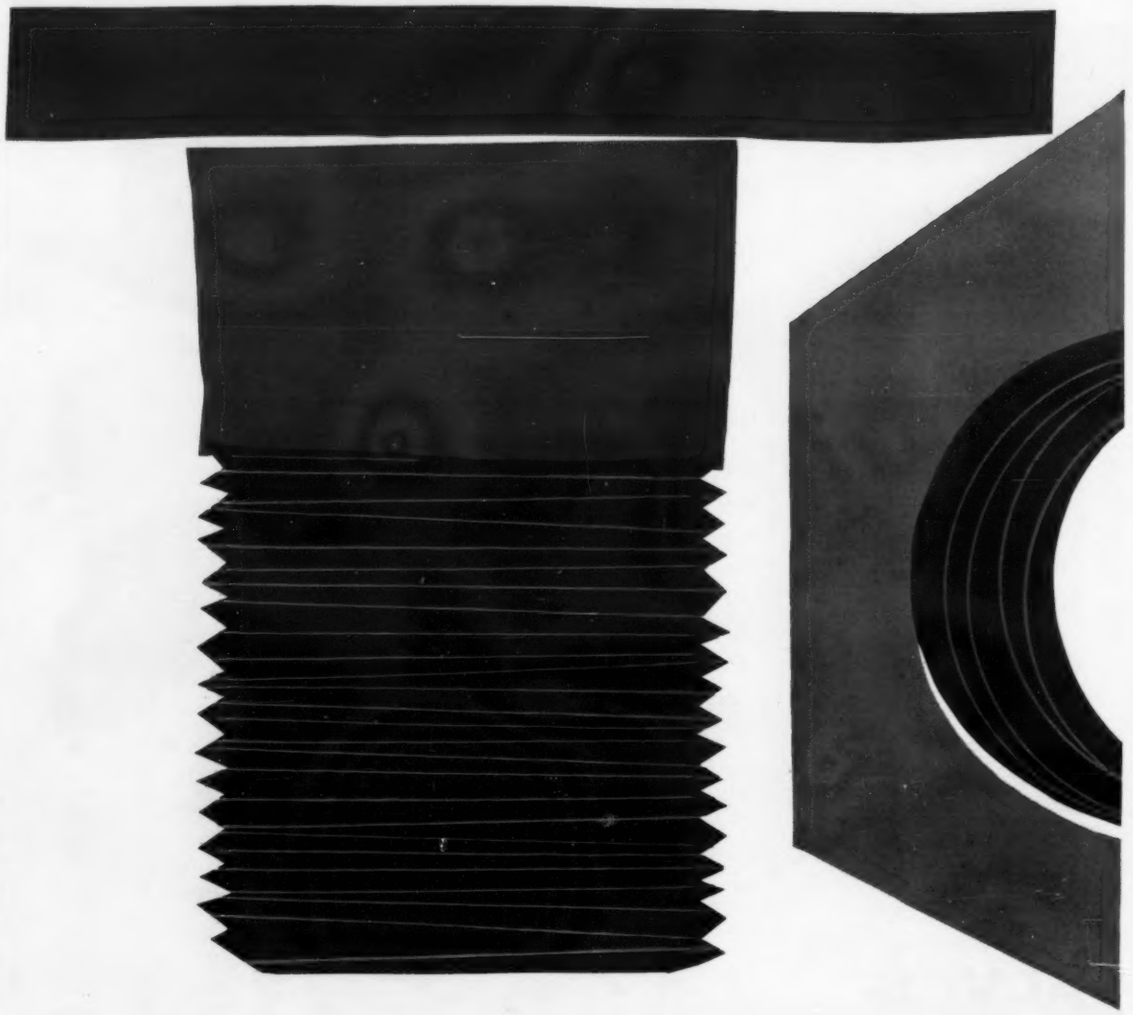
Nylon Hose . . . *Cont.*

ufacturing processes, rubber is limited to approximately 60-ft lengths in all sizes. TFE varies from 300- to 50-ft lengths depending on the size from small to large diameter, respectively. Nylon hose, on the other hand, is available in 500- to 200-ft lengths. The longer lengths of hose eliminate fittings in long runs and also effect savings by reducing the amount of scrap hose.

TABLE 3	RESISTANCE TO CHEMICAL AGENTS					
RATINGS: 1 – Good, 2 – Fair, 3 – Depends on conditions, X – Unsuitable						
	NYLON	BUTYL	BUNA–N	GR–S	NEOPRENE	TEFLON
Hydraulic Oil	1	X	1	–	2	1
Pydral	1	1	3	X	3	1
Pydraul F–9	1	1	X	–	X	1
Skydrol	1	1	3	X	3	1
Toluene	1	X	1–X**	X	2–X**	1
Fuel Oil	1	X	1	X	2	1
Gasoline	1	X	1	X	1	1
Kerosene	1	X	1	3	2	1
Lubricating Oils	1	X	1	2	1	1
Petroleum Oils	1	X	1	3	1	1
Lacquers	1	X	X	X	X	1
Lacquer Solvents	1	X	X	X	X	1
Acetic Acid	X	1	2	X	2	1
Acetone	1	1	X	1	3	1
Air	1	1	1	1	1	1
Anhydrous Ammonia Gas	2	1	3	3	3	1
Ammonium Chloride	3	1	–	–	1	1
Ammonium Hydroxide	1	1	3	3	3	1
Barium Chloride	X	1	1	1	1	1
Barium Sulphide	2	1	1	1	1	1
Benzene, Benzol	1	X	X	X	X	1
Boric Acid	2	1	1	1	1	1
Carbolic Acid, Phenol	X	X	X	X	3	1
Carbon Tetrachloride	1	X	X	X	X	1
Chlorine, dry, wet	X	2	2	2	2	1
Chlorinated Solvents, dry, wet	2	X	3	X	X	1
Ethers	1	3	3	3	3	1
Freon	1*	2	2	X	2	1
Hydrochloric Acid, 150F	X	1	1	2	2	1
Mercury	1	–	–	–	–	1
Steam	X	3	3	–	3	1
Trichlorethylene	1	X	3	X	3	1
Water, fresh (tap, b' l' r' P d, etc.) distilled lab grade, return condensate	1	1	1	1	3	1
Water, seawater	1	1	1	1	3	1

* Freon 22–2

** Depending upon manufacturer's rating



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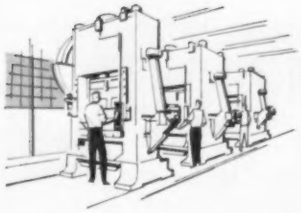

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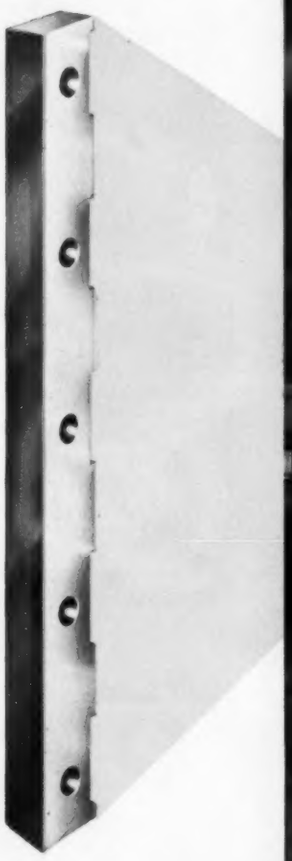

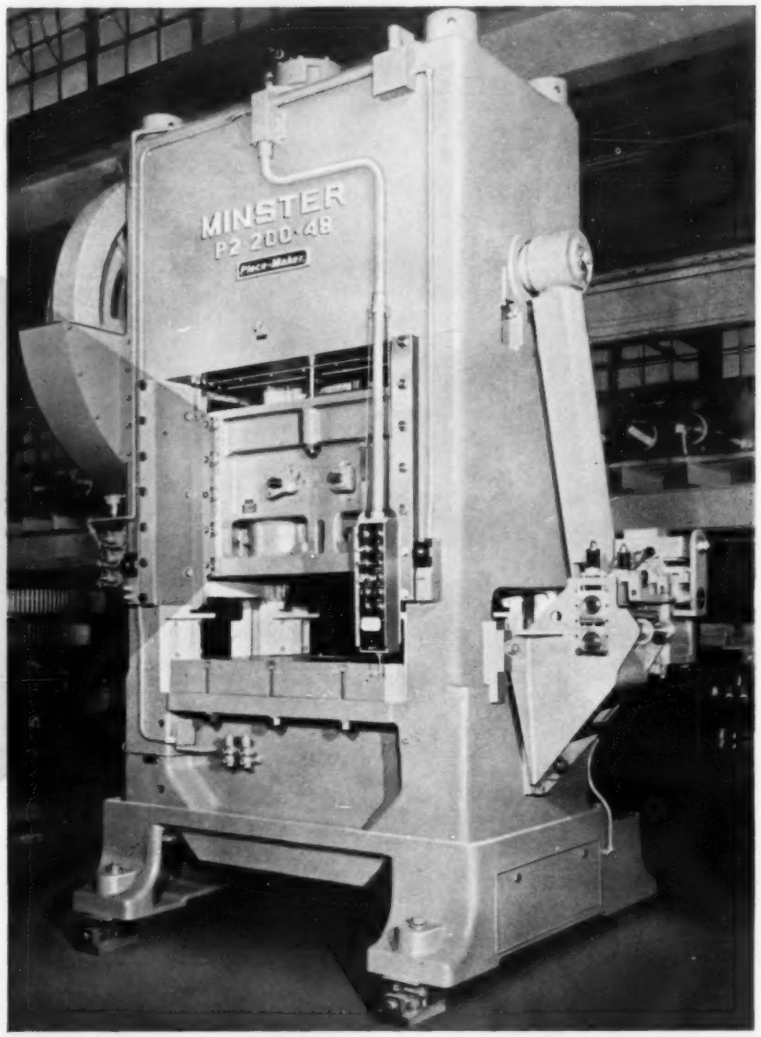

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Chemical Considerations

Resistance of hose to degradation by the fluid flowing through it is equally as important as burst strength and other physical considerations. Table 3 indicates the reaction of nylon, "Teflon" and several different rubber compounds to various chemical agents normally encountered.

In general, nylon pressure hose is resistant to aliphatic and aromatic hydrocarbons, almost all solvents, neutral salts, most alkalies to pH-11, and ozone. It has low freon permeability—approximately 1/10 that of rubber hose. Nylon hose is odorless, noncorrosive, fungus resistant and will not embrittle or deteriorate in storage under normal atmospheric conditions.

Nylon hose is unaffected by most flammable and nonflammable hydraulic fluids. Tests at 150F for 1000 hr indicated the hydraulic fluids listed in Table 4 can be used without degradation or swelling of inner core. Conventional hose, with the exception of TFE, varies considerably depending on the composition of the fluid. For example, butyl is recommended for "Skydrol" but is completely unsuitable for petroleum based hydraulic fluids.

Lacquer solvents deteriorate hose at an ex-

TABLE 4 NYLON HOSE RESISTANCE TO HYDRAULIC FLUIDS

TYPE FLUID	RATING
Pydraul[1] 150	Good
Pydraul[1] 600	Good
Pydraul[1] 625	Good
Pydraul[1] F–9	Fair
OS–45[1] Type III	Good
OS–45[1] Type IV	Good
Skydrol[1]	Fair
Skydrol[1] 500	Good
Houghto–Safe[2] 620	Good
Houghto–Safe[2] 1120	Fair
Houghto–Drive[2] M.I.H. – 10	Good
Hydrolubric[2] F. R.	Good
Ucon[3] Fluid Lb–300X	Good
Ucon[3] Fluid 50–HB–260	Good
Ucon[3] Fluid 150–CP	Good

1. Trademark: Monsanto Chemical Company
2. Trademark: E. F. Houghton and Company
3. Trademark: Union Carbide Corporation

(Continued on next page)

Nylon Hose . . . *Cont.*

tremely rapid rate. New airless spray systems subject hose to stringent conditions as the paint is heated as high as 180F and pressurized to 1200 psi. Under these conditions, reinforced rubber hose cannot be considered. Stainless-steel wire-braided TFE and nylon hose are both used for this application.

As can be seen from the chemical resistance table, nylon and TFE hose both are rated as good for all fluids conventionally used in paint systems. Chemically, there is little difference. Nylon hose has better mechanical strength, will withstand higher working pressures and is much lighter—1/3 to 1/2 the weight of TFE hose. There is little difference between the OD/ID ratios. The big difference between the two hoses is the price as Teflon hose costs three times more than nylon hose.

In most instances, the designer has a selection of two or three hoses that will provide suitable resistance to lubricants and fuels. Nylon is unaffected by the common fuels such as gasoline, fuel oil, kerosene or by the more exotic fuels such as hydrazine and other rocket fuels. Petroleum crudes, refined lubricating oils and the synthetic lubricants also have negligible effect on nylon hose.

Thermal Considerations

Nylon hose retains flexibility and toughness at temperatures as low as —65F, but can be used at temperatures as low as —200F and can operate intermittently in temperatures as high as 300F. The hose retains the strength of the basic polyamide at elevated temperatures and has a high modulus of elasticity.

Electrical Considerations

Electrical characteristics are frequently of importance when hydraulic lines must be nonconductive. Any metal-reinforced hose is unsuitable since the metal braid conducts the electrical charge. One special rubber hose used for an application of this nature consisted of three separate braids of nylon and four extruded sections of rubber. It develops electrical leaks at 10-15 kv and punctures at the test electrodes at 20 kv. Nylon hose used to replace this does not break down even at 50 kv. In addition, the nylon hose costs 30 percent less than the rubber hose. Conversely, if required, nylon hose also can be made conductive to drain static electricity similar to that encountered in the paint spray field.

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Circle 527 on Reader-Service Card

ALMOST ANYTHING CAN BE IMPROVED... IN PLASTICS MOLDED BY GENERAL AMERICAN

AMF wanted a durable, lightweight, inexpensive child's car body. General American helped provide the answer.

Every youngster can now drive around in style—and the Junior Toy Division of AMF has an exceptionally marketable entry in the truly compact car field. By replacing metals with molded plastics in the body and steering column, General American helped AMF save over two-thirds on tooling costs alone. What's more, there are fewer assembly operations and the color is molded right in. Even silk screening on the sides is done by General American before these components are delivered to AMF. The lighter weight cuts shipping costs, too.

Resourceful solutions to plastics problems are to be expected at General American, where plastics specialists are backed by the largest and most varied molding facilities in the world. For the Space Scout, General American specialists helped engineer the components, made and tested the prototype, developed the method of silk screening, and then molded the parts of high density polyethylene.

If you'd like to move more profitably into plastics, you'll certainly find it pays to plan with General American.

PLASTICS DIVISION
GENERAL AMERICAN
TRADE MARK

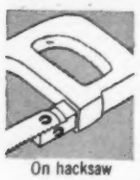
Plastics Division
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South La Salle Street • Chicago 3, Illinois • Offices in principal cities

Circle 105 on Reader-Service Card for more information

Use it for positioning... SEL-LOK spring pin

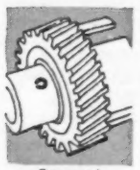
On food mixer

- Swift fastening—just drill and drive
- Secure locking—won't work loose despite shock or vibration
- Eliminates costly tapping, reaming, peening, milling
- Can be reused repeatedly
- 101 uses—as keys, cotter pins, axles, hinge pins, wrist pins, stop pins, pivots, etc.

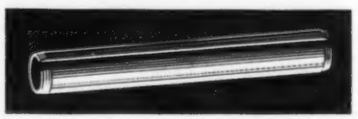


On hacksaw

SEL-LOK spring pins are available in carbon and corrosion-resistant steel (from 1/16 x 3/16 through 1/2 x 4 in.) and beryllium copper (1/16 x 3/16 through 1/4 x 3 1/2 in.). See your SPS distributor or write for Bulletin 2670.



On gear in assembly



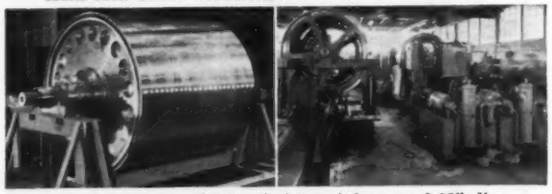
INDUSTRIAL FASTENER Division SPS

JENKINTOWN 6, PENNSYLVANIA

Circle 106 on Reader-Service Card for more information

Specialists in Deep Hole Drilling

— the kind your own shop shies away from and on which you can't afford the excessive costs, long tooling delays and scrap that goes with trial and error methods.



How tough can drilling be! 3 stainless steel 62" dia. forged rings, 22" long. 288 evenly spaced slots drilled and broached the length of the exterior wall of each ring as a separate project. When rings were assembled and bolted together, holes lined up perfectly.

We have 32 deep hole machines specially engineered to produce holes as small as .094" in depths up to 200 times diameter. Can hold close tolerances practically free of run-out. Also contouring and secondary operations. Drilled heat exchangers a specialty. Cleared for secret government work. WRITE FOR BROCHURE "HOLES".

20TH CENTURY MACHINE CO. / UTICA, MICH. PHONE JE. 9-0660

Circle 107 on Reader-Service Card for more information

Bending Stress in a Loaded Ring

Richard Wadler, Mechanical Engineer, Raytheon Co., Bedford, Mass.

The nomogram represents the equation:

$$S = 1.621\ PD/d^3$$

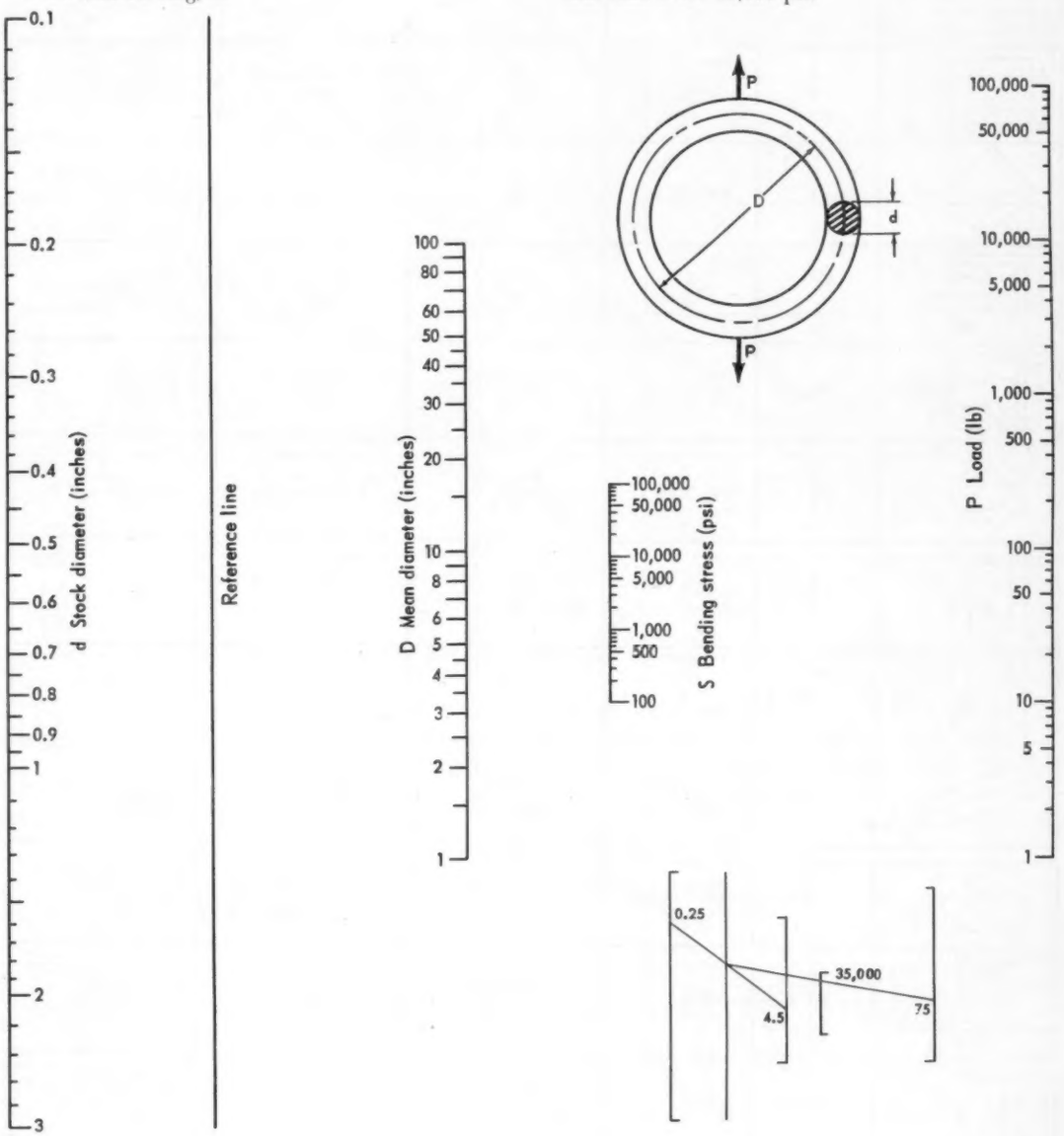
Where:

S = bending stress in a loaded ring in which the stock diameter d is small compared with mean diameter D, psi.

P = load on ring, lb

Example: Find the bending stress in a ring with a 4.5-inch mean diameter and 0.25-inch stock diameter which is subjected to a load of 75 lb.

Solution: Align stock diameter d = 0.25 with mean diameter D = 4.5, intersecting the reference line. Align this intersection with P = 75 and read S = 35,000 psi.



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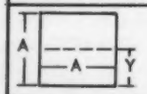
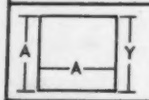
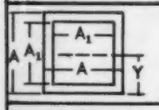
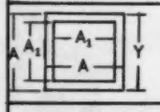
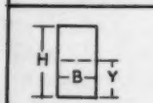
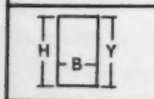
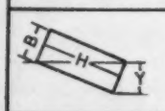
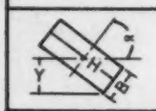
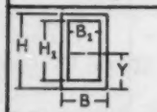
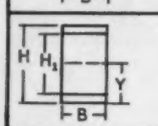
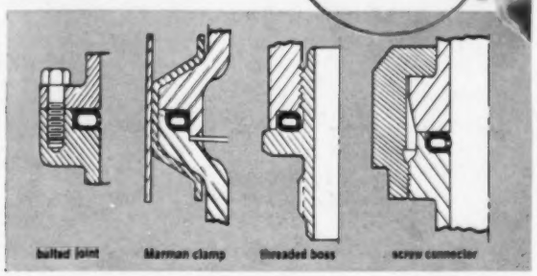
Properties of Various Sections

David P. Costa, Jersey City, N. J.

	Area of section (A)	Distance from axis to (Y) and (Y_1)	Moment of inertia (I)	Section modulus (S)	Radius of gyration (r)
	A^2	$Y=\frac{A}{2}$	$\frac{A^4}{12}$	$\frac{A^3}{6}$	0.289 A
	A^2	$Y=A$	$\frac{A^4}{3}$	$\frac{A^3}{3}$	0.577 A
	A^2	$Y=0.707A$	$\frac{A^4}{12}$	$0.118\ A^3$	0.289 A
	$A^2-A_1^2$	$Y=\frac{A}{2}$	$\frac{A^4-A_1^4}{12}$	$\frac{A^4-A_1^4}{6A}$	$\sqrt{\frac{A^2+A_1^2}{12}}$
	$A^2-A_1^2$	$Y=A$	$\frac{A^4-A_1^4}{3}$	$\frac{A^4-A_1^4}{3A}$	$\sqrt{\frac{A^2+A_1^2}{3}}$
	$A^2-A_1^2$	$Y=0.707A$	$\frac{A^4-A_1^4}{12}$	$0.118\frac{A^4-A_1^4}{A}$	$0.289\sqrt{A^2+A_1^2}$
	BH	$Y=\frac{H}{2}$	$\frac{BH^3}{12}$	$\frac{BH^2}{6}$	0.289 H
	BH	$Y=H$	$\frac{BH^3}{3}$	$\frac{BH^2}{3}$	0.577 H
	BH	$Y=\frac{BH}{\sqrt{B^2+H^2}}$	$\frac{(BH)^3}{6(B^2+H^2)}$	$\frac{B^2H^2}{6\sqrt{B^2+H^2}}$	$\frac{BH}{\sqrt{6(B^2+H^2)}}$
	BH	$Y=\frac{H\cos\alpha+B\sin\alpha}{2}$	$\frac{BH}{12}(H^2\cos^2\alpha+B^2\sin^2\alpha)$	$\frac{BH\left(H^2\cos^2\alpha+B^2\sin^2\alpha\right)}{6\left(H\cos\alpha+B\sin\alpha\right)}$	$\sqrt{\frac{H^2\cos^2\alpha+B^2\sin^2\alpha}{12}}$
	$BH-B_1H_1$	$Y=\frac{H}{2}$	$\frac{BH^3-B_1H_1^3}{12}$	$\frac{BH^3-B_1H_1^3}{6H}$	$\sqrt{\frac{BH^3-B_1H_1^3}{12(BH-B_1H_1)}}$
	$B(H-H_1)$	$Y=\frac{H}{2}$	$\frac{B(H^3-H_1^3)}{12}$	$\frac{B(H^3-H_1^3)}{6H}$	$\sqrt{\frac{H^3-H_1^3}{12(H-H_1)}}$

PRESSURE-TIGHT JOINTS 10^{-9} mm Hg-100,000 psi



United Self-Energized Metallic O-Rings*...

form positive, permanent, non-corrosive, static seals under pressure extremes from 10^{-9} mm Hg to 100,000 psi (or the ultimate compression stress of the metal itself) and temperatures from −452° to 3000° F. Available in various metals and coatings (including Teflon** and silver) ¼" O.D. to any size and configuration. United also makes non-vented and pressure-filled O-rings.

United Metallic "O" Rings, manufactured by United Aircraft Products, Inc., Box 1035, Dayton, Ohio.

See United Metallic O-Ring Catalog in Sweet's Product Design File or write for Free Handbook

*Patents 2,809,289; 2,837,360
**DuPont registered trademark

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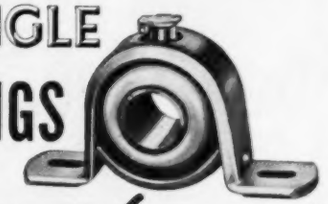
TRIANGLE BEARINGS with *Engineered* INDIVIDUALITY



Triangle fits the bearing to the application. Whether you can use a standard, like the Pillow Block above, or need a special such as the Pedestal or Clamshell Bearings shown below, your particular bearing problem receives the individual attention best assuring cost reductions — quality improvements.

SELF-ALIGNING . . . SELF-LUBRICATING SLEEVE-TYPE PILLOW BLOCKS

The widest selection of mountings available — functionally designed, efficiently produced. Experienced sales engineers available to help you anywhere. Phone or write for descriptive literature.

TRIANGLE MANUFACTURING CO.
732 Division St. Oshkosh, Wisconsin

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SILVER PLATING on the job

EASILY APPLIED

Cool-Amp can be applied on the job. The only equipment needed is a clean rag, a wire brush and some water. Cool-Amp contains no cyanide and can be used in underground vaults, substations and hard to get at places by several persons at the same time.

REDUCES RESISTANCE

Cool-Amp Powder deposits a genuine coat of silver that will not peel off. It prevents oxidation, minimizes overheating, thereby reducing maintenance. Provides cool maximum conductivity for all copper, brass or bronze current-carrying connections.

FREE SAMPLE—Write today for informative folder and free sample of Cool-Amp. One pound will silver plate approximately 6,000 square inches. $13.50 per pound—Shipped prepaid.

The COOL-AMP Co.

Dept. DN, 8603 S. W. 17th Avenue, Portland 19, Oregon

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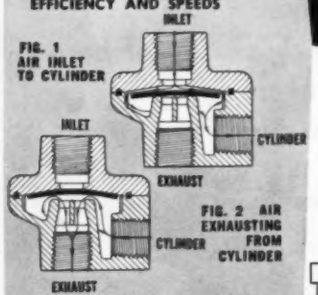
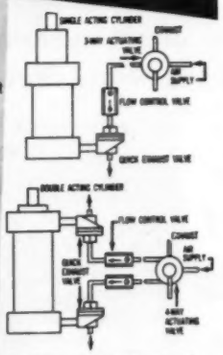
NEW! Pneu-trol® QUICK EXHAUST VALVE

Fast air dumping AT THE CYLINDER permits use of smaller valves and piping . . . INCREASES EFFICIENCY AND SPEEDS

Operating Pressures:
1 to 125 PSI
For ⅜" and ¼" pipe sizes



When control valve is opened air pressure seals exhaust port and diaphragm is deflected permitting air to pass thru the cylinder port (Fig. 1). When inlet pressure is relieved (by actuating valve in control circuit) the buildup of cylinder return pressure closes inlet port (Fig. 2) snapping the diaphragm off the exhaust port allowing instantaneous evacuation of exhaust air. *Write for complete details, specifications and prices.*



TYPICAL APPLICATIONS of Quick Exhaust Valves in Single and Double Acting Cylinders Because exhaust air is dumped at cylinder, smaller diameter piping and smaller selector valves can be used.

AUTO-PONENTS INC.
2921 Grant St. • Bellwood, Illinois

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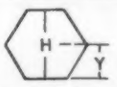
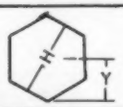
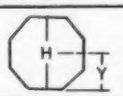
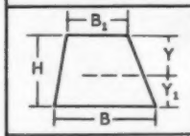
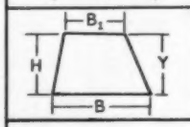
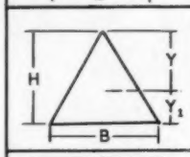
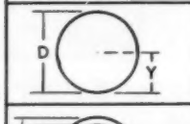
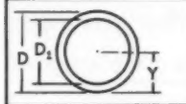
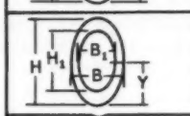
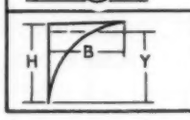
	Area of section (A)	Distance from axis to (Y) and (Y_1)	Moment of inertia (I)	Section modulus (S)	Radius of gyration (r)
	$0.866H^2$	$Y=\frac{H}{2}$	$0.06H^4$	$0.12H^3$	$0.264H$
	$0.866H^2$	$Y=0.577H$	$0.06H^4$	$0.104H^3$	$0.264H$
	$0.828H^2$	$Y=\frac{H}{2}$	$0.055H^4$	$0.109H^3$	$0.257H$
	$\frac{H(B+B_1)}{2}$	$Y=\frac{H(B_1+2B)}{3(B_1+B)}$ $Y_1=\frac{H(B+2B_1)}{3(B+B_1)}$	$\frac{H^3(B^2+4BB_1+B_1^2)}{36(B+B_1)}$	$\frac{H^2(B^2+4BB_1+B_1^2)}{12(B_1+2B)}$	$\frac{H}{6(B+B_1)}\sqrt{2(B^2+4BB_1+B_1^2)}$
	$\frac{H(B+B_1)}{2}$	$Y=H$	$\frac{H^3(B+3B_1)}{12}$	$\frac{H^2(B+3B_1)}{12}$	$\frac{H}{\sqrt{6}}\sqrt{\frac{B+3B_1}{B+B_1}}$
	$\frac{BH}{2}$	$Y=\frac{2H}{3}$ $Y_1=\frac{H}{3}$	$\frac{BH^3}{36}$	$\frac{BH^2}{24}$	$0.236H$
	$\frac{BH}{2}$	$Y=H$	$\frac{BH^3}{12}$	$\frac{BH^2}{12}$	$0.408H$
	$0.7854D^2$	$Y=\frac{D}{2}$	$0.049D^4$	$0.098D^3$	$\frac{D}{4}$
	$0.7854(D^2-D_1^2)$	$Y=\frac{D}{2}$	$0.049(D^4-D_1^4)$	$0.098\frac{D^4-D_1^4}{D}$	$\frac{\sqrt{D^2+D_1^2}}{4}$
	$0.3927D^2$	$Y=0.288D$ $Y_1=0.212D$	$0.0069D^4$	$0.0238D^3$	$0.132D$
	$0.7854BH$	$Y=\frac{H}{2}$	$0.049BH^3$	$0.098BH^2$	$\frac{H}{4}$
	$0.7854(BH-B_1H_1)$	$Y=\frac{H}{2}$	$0.049(BH^3-B_1H_1^3)$	$0.098\frac{BH^3-B_1H_1^3}{H}$	$0.25\sqrt{\frac{BH^3-B_1H_1^3}{BH-B_1H_1}}$
	$\frac{0.2146r^2}{(B=H=r)}$	$Y=0.7767r$	$0.0075r^4$	$0.0097r^3$	$0.187r$

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Specifying Purity of Air

And Other Gases

James R. Clark, Jr., Chief Engr.,
Robbins Aviation Inc., Los Angeles, Calif.

There is a vital need for standard terminology and standard reference units when discussing, specifying, buying or selling air and gas purification equipment, especially at operating pressure from 1000 to 12,000 psi.

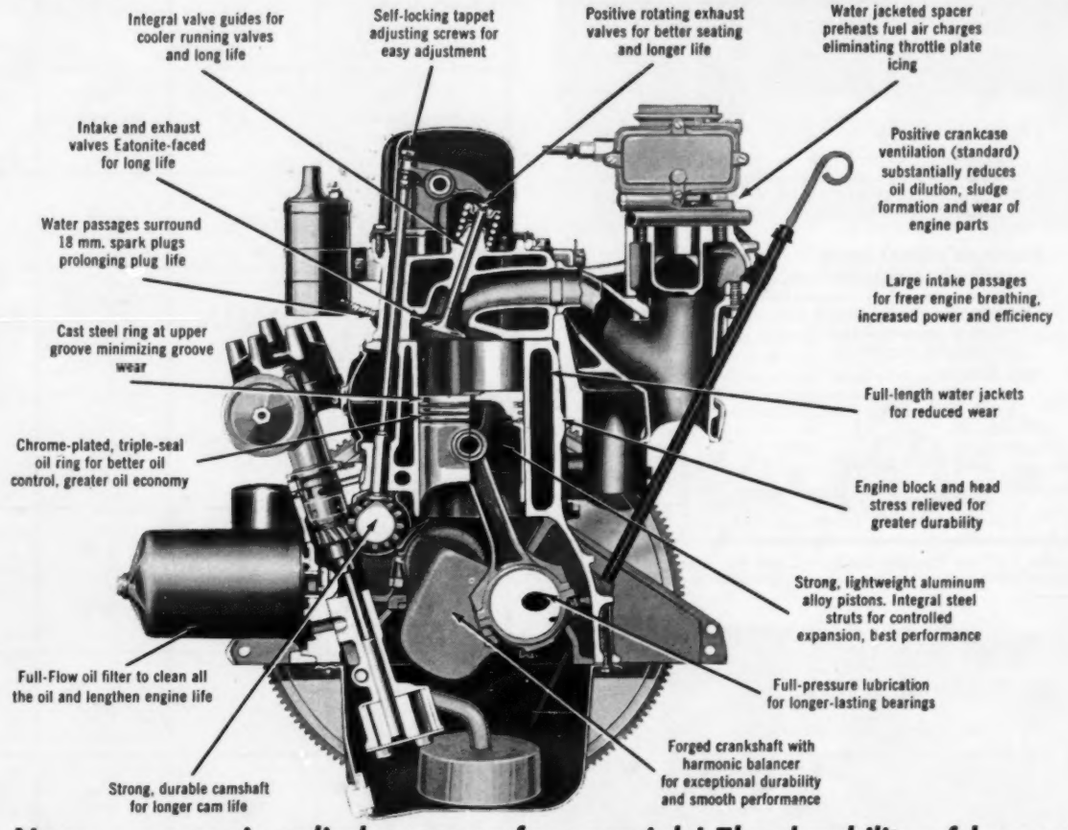
When specifying water vapor (or moisture) content of a gas, the following terms and others are available to choose from: (1) relative humidity; (2) absolute humidity; (3) specific humidity; (4) percent of saturation; (5) percent of water by volume; (6) parts water vapor per million parts air by weight; (7) parts water vapor per million parts air by volume; (8) dewpoint in degrees F or degrees C; (9) pounds of water per cu ft of gas; (10) grains per lb; (11) grains per cu ft; (12) pounds of water per lb of gas; (13) milligrams per liter; (14) milligrams per lb; (15) milligrams per standard cu ft of mixture; (16) milligrams per actual cu ft of mixture, and (17) partial pressure of the water vapor.

Many of these terms require qualifying conditions, such as the pressure and temperature, to be meaningful. Also, moisture content below 32F can be based on vapor pressure over water or over ice; it can be stated on a "wet" or "dry" basis; it can be referenced to 20C and 1 atmosphere as a standard temperature and pressure or 70F and 1 atmosphere or at whatever temperature may be desired and at whatever pressure is involved.

The actual measurement of dewpoints below —100F has not proved practical outside of laboratories. Although a —180F dewpoint may be actually produced, even liquid nitrogen at —320F is possible with only a —90F dewpoint when vaporized in a vented container. Remember, —100F dewpoint is only one part in one million.

Another point sometimes overlooked is that even though an extremely low dewpoint may be produced at the outlet port of the purification equipment, it is immediately increased by moisture from lines and connection points regardless of pressure inside the system. "Teflon" and stainless steel seem to be the best materials for connection lines, but even they require heating and purging to become stable. Lines of copper and

ALL-NEW 262 CUBIC INCH SIX JOINS FORD INDUSTRIAL ENGINE LINE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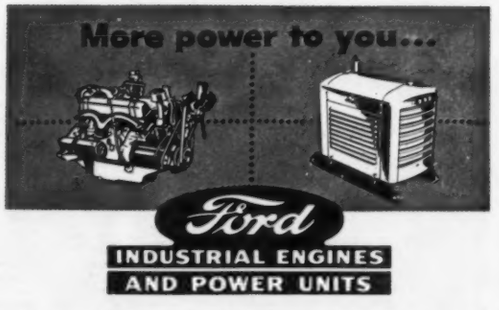

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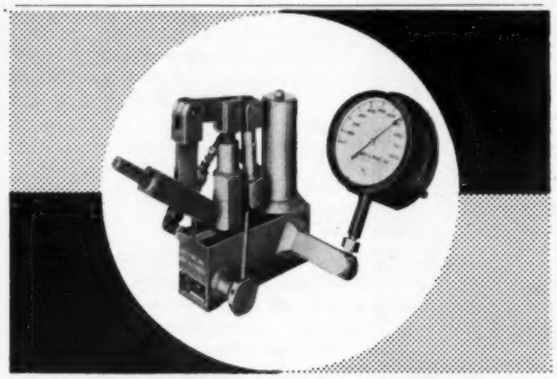

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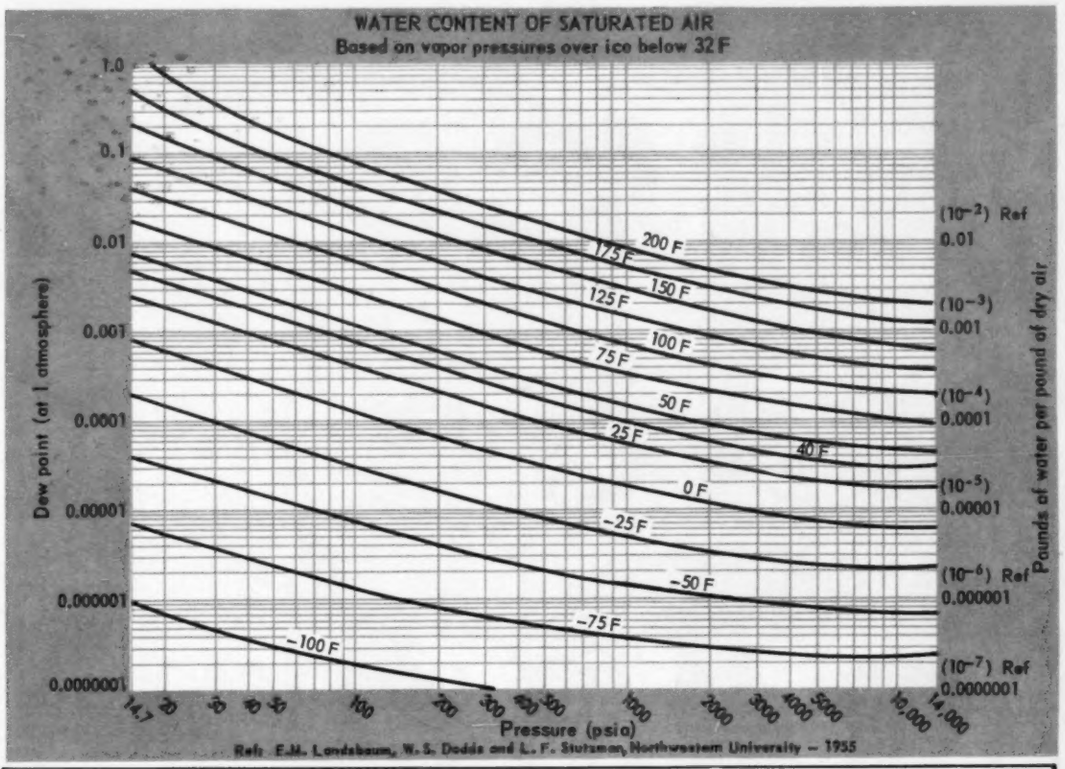
pipe with pipe fittings sealed with pipe dope are examples of trouble sources.

So-called "dry" nitrogen or other high-pressure gases in cylinders will absorb moisture from metal cylinder walls as the cylinder pressure drops, to the extent that a —75F dewpoint initially at 2000 psi will change to —50F or less when the cylinder pressure is reduced to 100 psi.

When specifying oil vapor content or hydrocarbon content of a gas, parts per million by volume (ppm/v) or parts per million by weight (ppm/w) are commonly used terms. With ppm/v, a reference to a hydrocarbon must be also stated, such as "hexane", for a complete statement of an absolute amount. Also, the parent gas must be stated.



CONVERSION TABLE
From PPM/W to PPM/V and vice versa of H_2O and HC from C_1 to C_x in various parent gases

Formulas: $PPM/W = \frac{PPM/V \times \text{Mol. weight impurity}}{\text{Mol. weight parent gas}} = A$ $PPM/V = \frac{PPM/W \times \text{Mol. weight parent gas}}{\text{Mol. weight impurity}} = B$

Carbon = 12 mol. weight = 12 atomic weight Hydrogen = 2 mol. weight = 1 atomic weight
Helium = 4 mol. weight = 4 atomic weight Nitrogen = 28 mol. weight = 14 atomic weight
Oxygen = 32 mol. weight = 16 atomic weight

ONE PPM/V AS	Mol. Wt.	Mol. Size Angstroms	(A) EQUIVALENT PPM/W IN PARENT GAS				
			Air (29)	Helium (4) (2.6) (2.6) (4.0)	Hydrogen (2) (2.4) (2.4) (3.0)	Oxygen (32) (2.8) (2.8) (3.8)	Nitrogen (28) (3.0) (3.0) (4.09)
Water H_2O	18		0.62	4.5	9.0	0.56	0.64
Methane CH_4	16	(4.00) (4.00) (4.00)	0.55	4.0	8.0	0.50	0.57
Ethane C_2H_6	30	(4.00) (4.00) (5.54)	1.03	7.5	15.0	0.94	1.07
Propane C_3H_8	44	(4.89) (4.00) (6.52)	1.51	11.0	22.0	1.37	1.57
Butane C_4H_{10}	58	(4.89) (4.00) (7.78)	2.00	14.5	29.0	1.81	2.07
Pentane C_5H_{12}	72	(4.89) (4.00) (9.04)	2.48	18.0	36.0	2.25	2.57
Hexane C_6H_{14}	86	(4.89) (4.00) (10.34)	2.96	21.5	43.0	2.68	3.07
ONE PPM/W AS	**Mol. Wt.**	**Mol. Size Angstroms**	**(B) EQUIVALENT PPM/V IN PARENT GAS**				
			Air (29)	Helium (4) (2.6) (2.6) (4.0)	Hydrogen (2) (2.4) (2.4) (3.0)	Oxygen (32) (2.8) (2.8) (3.8)	Nitrogen (28) (3.0) (3.0) (4.09)
Water H_2O	18		1.61	0.222	0.111	1.77	1.55
Methane CH_4	16	(4.00) (4.00) (4.00)	1.81	0.25	0.130	2.00	1.75
Ethane C_2H_6	30	(4.00) (4.00) (5.54)	0.97	0.13	0.067	1.07	0.93
Propane C_3H_8	44	(4.89) (4.00) (6.52)	0.66	0.09	0.046	0.73	0.64
Butane C_4H_{10}	58	(4.89) (4.00) (7.78)	0.50	0.069	0.034	0.55	0.48
Pentane C_5H_{12}	72	(4.89) (4.00) (9.04)	0.40	0.055	0.028	0.44	0.39
Hexane C_6H_{14}	86	(4.89) (4.00) (10.34)	0.34	0.046	0.023	0.37	0.33

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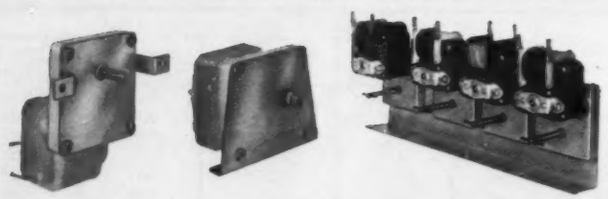

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NEW LITERATURE

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Aluminum Screw Machine Stock 451

A 154-page handbook is claimed to be the most comprehensive source of information ever compiled on machining aluminum. The manual replaces two earlier machining editions, "Alcoa Aluminum in Automatic Screw Machines" and "Screw Machine Stock . . . Estimating and Operating Data", updating and combining their contents. Intended as an aid to designers in specifying material and to operators in attaining correct machining practices, the book contains four tabbed sections covering general information, properties and tolerances, estimating information, and tooling and operating data. Section one summarizes mechanical and physical properties and machining characteristics, and lists sizes, tempers and applications for each of the five standard aluminum screw machine stock alloys. Data in other sections include machinability ratings, recommended thermal treatments, tolerances, and recommended feeds and speeds. Complete weight tables, screw thread data, recommended cutting fluids and lubricants, tool description and finishes complete the manual. Aluminum Co. of America, 728 Alcoa Bldg., Pittsburgh 19, Pa.

Miniature Screw and Screw Threads Standards 452

A condensation of standards representing the first official American standardization of screw threads smaller than 0-80, covering sizes as small as 0.0118-318. An essential reference for anyone using small screw threads, especially those engaged in government projects. Form 861, two pages, also includes standards for miniature screws with fillister, pan, flat and binding heads. A table of standard lengths is included and manufacturing and NAS specifications are given. J. I. Morris Co., 394 Elm St., Southbridge, Mass.

Electronic Hardware 453

This reference manual contains a comprehensive listing of spacers and standoffs available from stock. Other revised sections planned for this manual include material on handles, terminals and general electronic hardware. A complete data section is included in the present material providing decimal equivalents of fractions and millimeters, a cross-reference for spacers and standoffs, charts giving properties of rubber screw threads and tap drill sizes, physical properties of the elements, a standard atmospheric table, a table of conversion factors, a temperature conversion chart and a metric conversion table. Amatom Electronic Hardware Co., Inc., 88 Drake Ave., New Rochelle, N.Y.

Jig and Fixture Component Conversion Chart 454

This conversion chart lists identical jig and fixture components from several different companies and will aid in bulk ordering. The four-page chart covers swing "C" washers, spring plungers, plastic ball knobs, quarter-turn screws, long quarter-turn screws, jig feet and rest buttons, shoulder screws, latch bolts, fixture keys, T-nuts, cast-iron hand knobs, spherical washers, flat washers, knurled head screws, flanged nuts and coupling nuts. Northwestern Tools, Inc., 115 Hollier Ave., Dayton 3, Ohio.

Emergency Lighting Handbook 455

Form 6527, an eight-page technical handbook on automatic battery-powered emergency lighting equipment, offers complete technical descriptions including batteries, chargers, relays, connections, lamps and instrumentation lights and switches. All models provide emergency lighting automatically and instantaneously when normal electrical power fails. Of particular interest to architects and engineers are suggested methods for providing emergency lighting in two adjacent areas, in stairwells, or in several rooms by means of a single emergency unit equipped with remotely connected lamps. A graph shows a typical installation in a room 70 by 90 ft, showing light intensities of a single lamp at various distances. The approximate lamp illumination time given by various types of batteries for emergency service is shown in tabular form. Exide Industrial Marketing Div., The Electric Storage Battery Co., Rising Sun and Adams Aves., Philadelphia 20, Pa.

Protective Welding and Cutting Equipment **456**

Entitled "Personal Protective Equipment for Welding and Cutting", 20-page catalog (N-177) provides 68 pictures of helmets, hand shields, goggles, safety glasses, safety hats and caps, face shields, portable screens, gloves and mittens. Tables describe filter and protective plates, goggle lenses and visor replacements. NCG Div., Chemetron Corp., 840 N. Michigan Ave., Chicago 11, Ill.

Miniature Ball Bearings **457**

Two new lines of miniature bearings, ABEC 3 and 5, are described in a four-page folder. Bearing sizes available and their dimensions are shown in tabular form, along with tolerances and basic bearing numbers. The manufacturer claims these new low-cost bearings can reduce miniature ball bearing costs up to 60 percent. New Departure, Div. of General Motors Corp., Bristol, Conn.

Cable-Support Systems **458**

Catalog No. 106, 52 pages, aids selection and installation of the right section, type of bend or component part for supporting power cables, communication cables and automatic control or hydraulic line cables. Illustrations and descriptions show how, without the use of bolts, nuts, washers or pins, each component piece becomes a part of both simple and complicated cable-support installations. Chalfant Products Co., Inc., 11525 Madison Ave., Cleveland 2, Ohio.

Precision Gears and Instrument Clamps **459**

This 256-page catalog No. 6A offers the broadest line of stock miniature gears in Precision I, II and III available in the United States. Hundreds of new items are included, such as miniature stock gears with bores from 0.0900 to 0.3750 inch and face widths from 1/16 to 3/16 inch. New antibacklash gears and mechanical slip-clutches are shown and a one-piece flexible shaft coupling for misalignment corrections in servo and computer designs is featured. Complete specifications are provided for stock precision clamps, bearings, shafts, retaining rings, roll pins and electromechanical specialties. Perfect Gear and Instrument Corp., 339 S. Isis, Inglewood, Calif.

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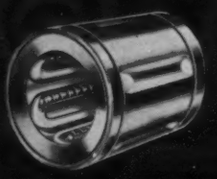

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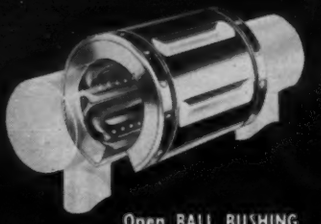

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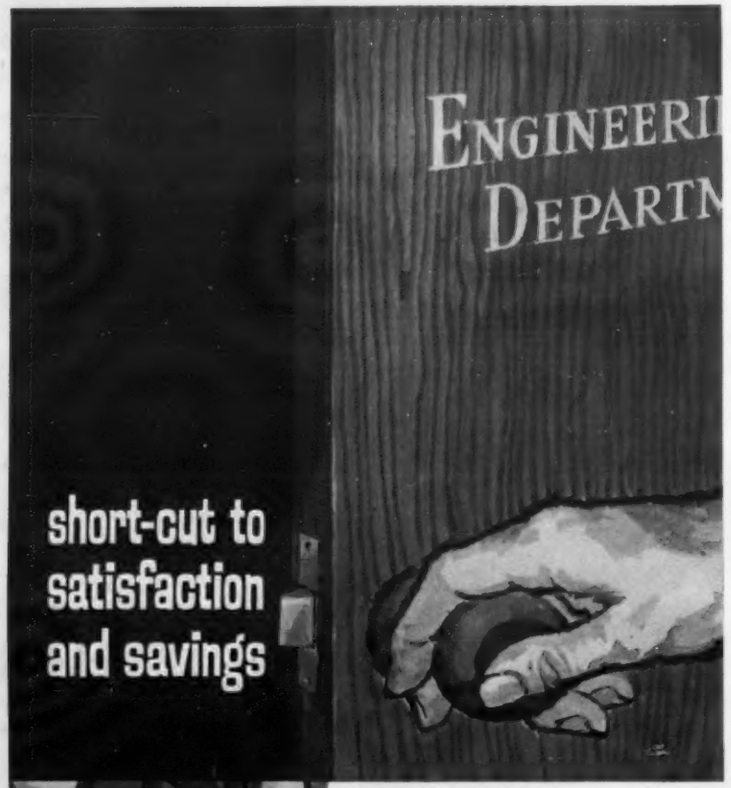

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LITERATURE

Relays and Timers 460

Technical data for a line of electromagnetic relays and motor-driven timers are found in Catalog 861A, 60 pages. Relays that can be custom-engineered to almost any requirement are described as well as motor-driven timer products. Featured timers include sequence, manual-reset, automatic-reset, cycle, delay and interval models. A brief history of the manufacturer and a description of the manufacturing facilities complete the booklet. Telex/Aemco, 24 State St., Mankato, Minn.

Miniature Precision Bearings 461

Believed to be the most complete compilation of engineering information in the miniature precision bearing industry, Catalog 6 contains new sizes and new types of bearings not previously cataloged. Included in the 64 pages of information are a section on nomenclature and another on failure analysis of particular interest to designers. Some of the other subjects covered are numbering systems, tables of dimensions, bearing type selection, load ratings, deflections, applications and packaging. Miniature Precision Bearings, Inc , Precision Park, Keene, N.H.

Craftsmen in Sheet Metal 462

"Craftsmen in Sheet Metal" tells a graphic story of what happens from the idea or blueprint stage to the finished metal products. Examples of finished products and the equipment used to make the products illustrate the 20-page story of these "craftsmen". A complete listing of equipment from the coil steel lines to finishing and shipping is provided. Units include shears, double crank presses, press brakes, punch presses, horn presses, spotwelders, production and toolroom equipment. Lyon Metal Products, Inc., 8 Plant Ave., Aurora, Ill.

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Grease Lubrication 464

Briefly presents the high spots and basic facts of the "story of grease", giving a fundamental understanding of the properties, function, types and uses of lubricating grease. The 32-page summary presents in easy-to-read form principles, properties, types and rules for choice and application of lubricating grease, including the effect of additives on the properties of grease. Bardahl Mfg. Corp., 1400 N. W. 52nd St., Seattle 7, Wash.

Designing Control Centers 465

Bulletin C-6300, 12 pages, is an easy guide for laying out and designing any control center, special or standard. Useful for architects, engineers and specification writers, the booklet's special features include simplified planning and ordering, less expensive installations, simplified operation and maintenance, greater safety and modern functional appearance. A time-saving work sheet and application guide completes the bulletin. Monitor Controller Div., Atlee Corp., 99 Grove St., Rockland, Mass.

Two-, Three- and Four-Way Valves 466

Valves for air, gas, water, steam, general oils and hydraulic oils in pressure ratings up to 4500 psi are featured in this 48-page catalog. A variety of manually operated, manual override solenoid-operated, solenoid-operated or controlled direct-acting, solenoid-controlled pilot-operated and other specialty pressure and flow control valves are described. Valve manifold units with or without subplate mounting are shown along with power and package units for grinding, lathe and plastic molding press control. Specialty valves are shown for refrigeration and air conditioning, temperature and pressure controls for industrial furnaces. Herion, Inc., Box 184, Valley Stream, N.Y.

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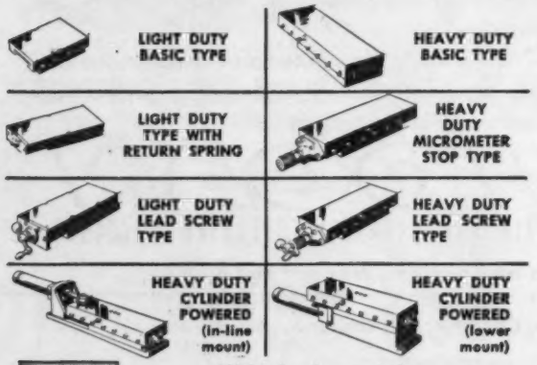
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Improved Function and Reduced Cost Through Well-Engineered Plastic Components

T. H. Risk, J. R. Forrester, Jr., and R. P. Schmuckal, Ford Motor Co.

In the competition among the 20 or more basic automotive materials, the expensive ones are chosen only when cheaper materials cannot meet requirements. However, it is the cost of the finished part, and not the material cost alone, that is the criterion for selection. The cost of fabrication must be added to the raw material cost to determine the relative costs of finished parts. Since fabrication of plastics is usually simple and inexpensive, these relatively high-priced materials are used to a greater extent than might be anticipated.

The introduction of new plastic materials has been an important factor in contributing to the increasing use of these materials. In 1940, there were four thermosetting and seven thermoplastics for a total of eleven materials in general automotive use. By 1950, three new thermosetting and two new thermoplastics were added, making the total sixteen. Between 1950 and 1960, six new thermoplastics were added, making the total 22. It is noticeable that during the past decade, emphasis has been on the development of new thermoplastics rather than the thermosetting materials. Although no new basic thermosetting materials have been developed recently, there have been many modifications offered, principally fillers such as glass that strengthen and give dimensional stability to the finished piece.

The seven thermosetting and 15 thermoplastics in general use today are shown in Fig. 2.

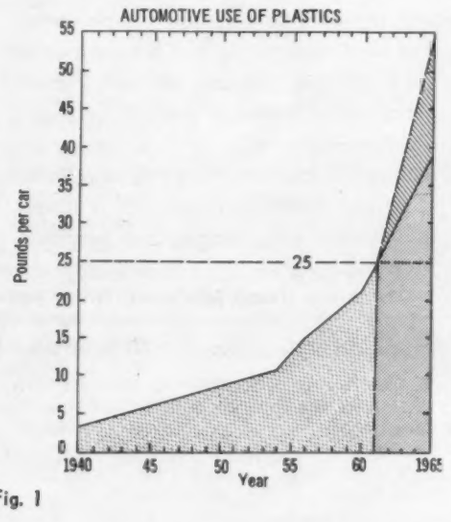


Fig. 1

Fig. 2

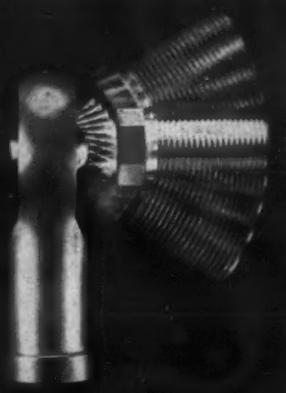
Price reductions have undoubtedly been a big factor in the increased automotive use of plastic materials during the past decade. A cost comparison of the "average" plastic with steel and aluminum on both a weight and volume basis is given in Fig. 3. It should be noted that while the average plastic has decreased 34.5 percent in price during the past six years, steel has increased 20 percent. On a volume basis, the plastic average cost is lower than aluminum and is rapidly approaching that of steel.

Plastics, as used on current cars, cover a wide variety of parts in diversified applications. Eleven basic polymers are used for about 170 plastic parts on the average vehicle. Some plastics are employed for a large number of applications, while others have very limited use. Nylon, for example, is used for a wide variety of parts, such as gears, bushings, fittings, fasteners and washers, many of which are used in a number of places on the car. Poly-vinyl-butyral, on the other hand, is used only as a safety-glass laminate—a very limited application.

Properties and Uses of Plastics

In the engineering of an automobile, one of the major decisions of the design engineer is what material to use for a given component.

One of the purposes of this paper is to aid the design engineer in the earlier stages of his materials selection problems. Comparative property data are presented on seven thermoplastics of greatest



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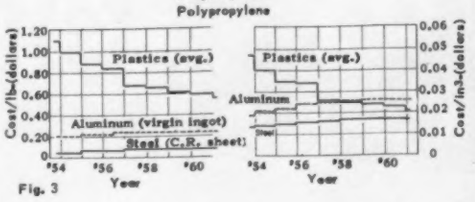

Fig. 3

current interest to automotive engineers—nylon, acetal, ABS, polycarbonate, polypropylene, high-density polyethylene and mathacrylate (see Fig. 4).

Eight properties are compared: tensile strength, percent elongation, tensile modulus, hardness, heat distortion temperature, impact strength, coefficient of thermal expansion and low-temperature properties as measured by low-temperature impact strength. These are properties common to most plastics and which usually are of concern to automotive design engineers. Unique properties of a given material are discussed later.

Based on these data and other pertinent information, the following discussions cover the properties and current potential usage of the seven thermoplastics in some detail.

Nylon

Nylon is the "old standby" plastic of the automotive industry. More plastic components by far are made of nylon than of any other material. However, its use usually is limited to functional parts of small size because of its relatively high cost (current price $0.98/lb, $1.10/lb-vol). Cost/lb-vol = cost/lb × specific gravity.

Nylon is one of the strongest and stiffest of the thermoplastics. These properties are coupled with relatively good impact strength, low friction, high resistance, good electrical properties, and high heat distortion temperatures (particularly at the lower stress levels). It is a most versatile plastic and is used in bushings, carburetor cams, windshield wiper and speedometer gears, door-latch wedges, electrical connectors, fuse holders and lamp bases. On the debit side, nylons are sensitive to moisture, the commonly used automotive nylon stabilizing at about 2.5 percent moisture content at 50 percent relative humidity, and increasing to 8.5 percent moisture content in water or 100 percent relative humidity. Increasing moisture content improves impact strength and elongation but adversely affects strength, modulus, creep and dimensional stability. Dimensional change amounts to about 0.020 inch per inch from an

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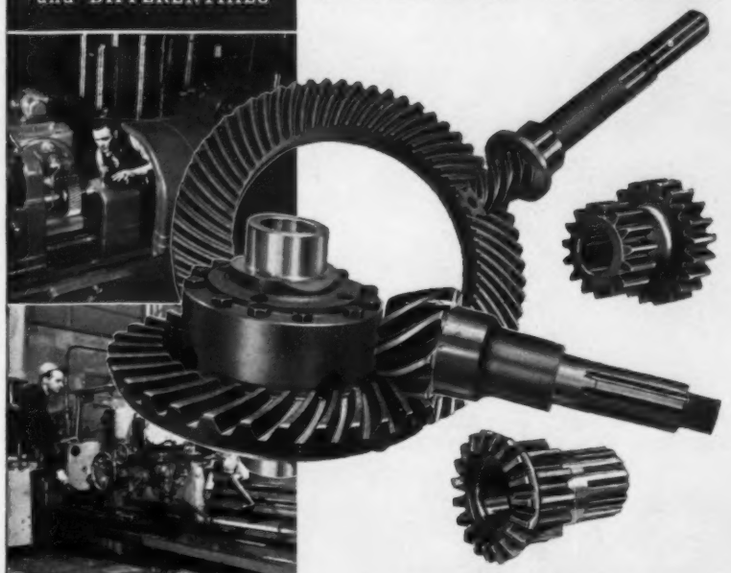

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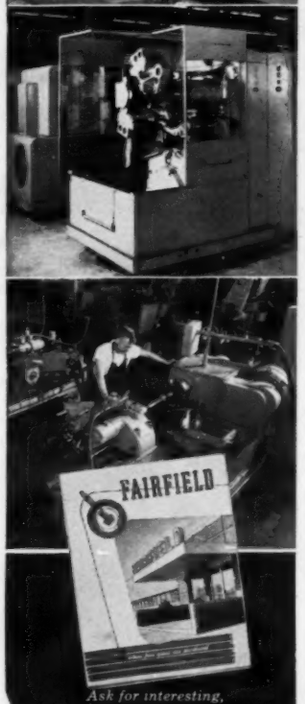

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equilibrium condition at 50 percent relative humidity to equilibrium at 100 percent relative humidity. This moisture sensitivity affects the design of nylon components and somewhat restricts the use of nylon.

Acetal

Acetal resin (plyformaldehyde) is a relative newcomer to the plastic fold, but already it is making a big impact upon automotive materials engineering. Physically, it is more like nylon than the other thermoplastics and already is less costly than nylon (current price—$0.65/lb, $0.93/lb-vol.).

Acetal possesses strengths similar to that of nylon, and its rigidity and hardness is somewhat in excess of the stiffest of nylons. Its resistance to heat is comparable to that of nylon under low stress conditions and significantly superior under high stress conditions. Additional advantages over nylon are low creep under load, higher load-carrying capacity, somewhat lower coefficient of thermal expansion and relative insensitivity to moisture with accompanying improved dimensional stability. Acetal's modulus is less temperature sensitive, and acetal better withstands sub-zero temperatures without embrittlement. Like nylon, it has outstanding resistance to automotive fuels and oils.

Polycarbonate

Polycarbonate is among the most recently developed thermoplastics to be made commercially available. Its unique properties indicate a good potential for specialized applications in the automotive industry, even at its present high price of $1.30/lb, $1.56/lb-vol. It is reported that volume usage would result in very sizable price reductions. Potentially, it could become competitive in cost with nylon and acetal.

Polycarbonate has strength, modulus and hardness properties comparable to those of many nylons and approaching those of acetal. It is an

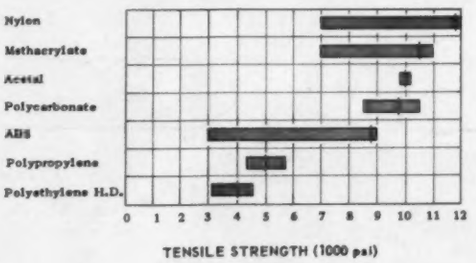

Fig. 4

(Continued on page 99)

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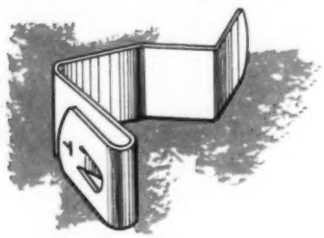

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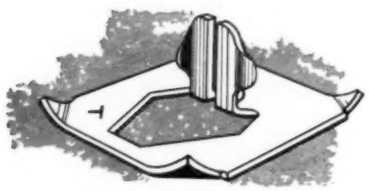

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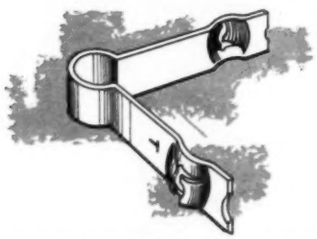

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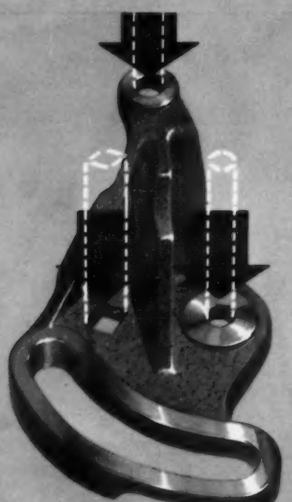

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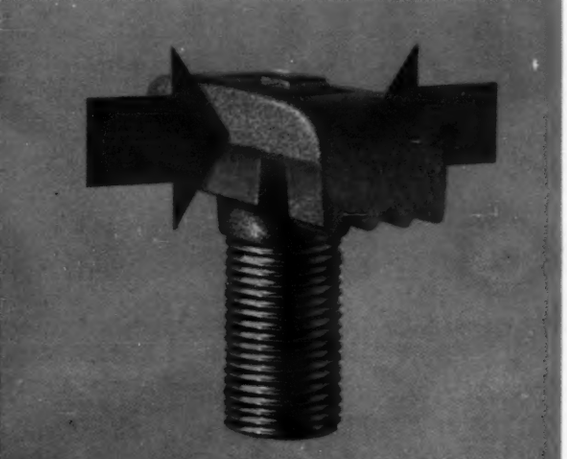

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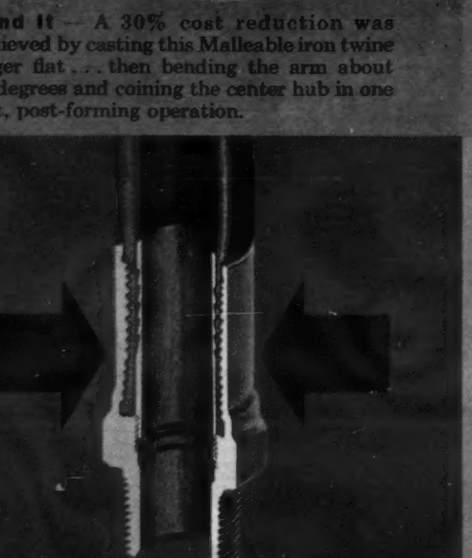

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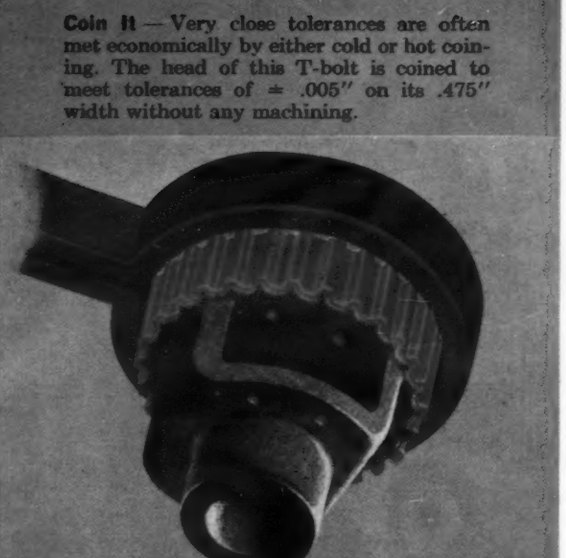

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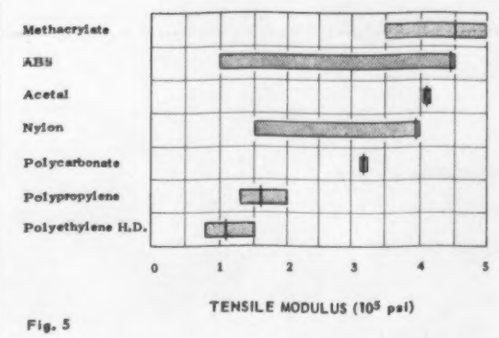

Fig. 5

exceptionally tough plastic with impact resistance far exceeding that of any other rigid plastic. This property, of course, results from its unique combination of high modulus and high elongation. Although reduced considerably at low temperatures, the impact resistance of polycarbonate at −40F is still about twice that of acetal, its closest rival.

Polycarbonate is resistant to heat. With regard to heat distortion temperatures, it is also unique in that its performance does not vary significantly with load. At high stress levels (264 psi), it far surpasses any other thermoplastic. Related to this property is its resistance to creep. Cold flow will not occur at stress levels up to one-fifth its ultimate strength. Added to these properties are dimensional stability, relative insensitivity to moisture, good electrical properties and transparency if necessary.

The combination of properties outlined above suggests polycarbonate's use for transparent housings and dials, cams, latches, bushings, precision gears that operate at low speeds and light loads but are subject to occasional impact, and for impellers and propellers, particularly if they may be struck by solid objects.

Methacrylate

The methacrylates were among the first of the thermoplastics to be adopted by the automotive industry. Outstanding among its properties are weather resistance, lustrous appearance and optical properties. Chiefly because of these properties, methacrylate has been used continuously for more than 20 years as a taillight lens material.

Methacrylate is among the hardest of the thermoplastics, with accompanying high modulus and tensile strength. In comparision with the other plastics described in this paper, it has extremely low elongation (3-5 percent). Nevertheless, its impact resistance is sufficient to make it acceptable for the components in which it is utilized. Its impact strength, somewhat strangely but fortunately, is not reduced at subzero temperatures down to −40F.

The high heat-resisting methacrylates show

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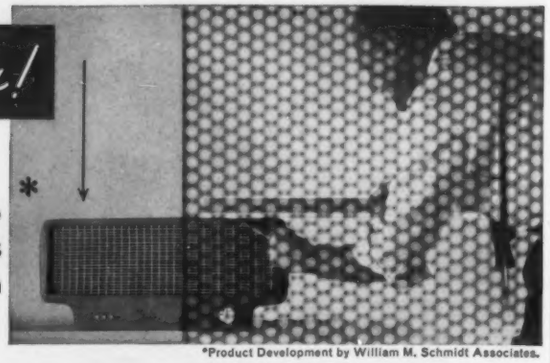

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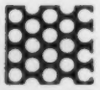

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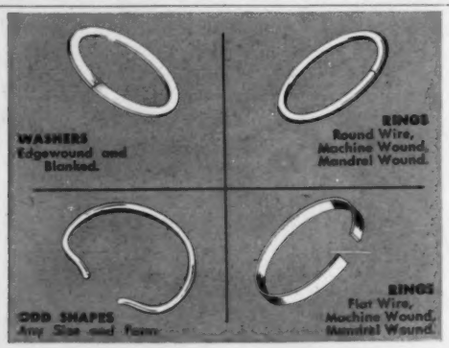

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heat distortion temperatures somewhat similar to the ABS materials—below nylon, acetal and polycarbonate; above polypropylene and the polyethylenes. In the automotive industry it is not considered a structural-type plastic, principally because of its tendency toward brittleness. It is extremely notch-sensitive, and cracks progress rather easily.

ABS

ABS materials (acrylonitrile, butadiene and styrene terpolymers and blends) are formulated to cover an extremely wide range of flexibilities, extending from pliable, automotive crash-pad covers to rigid, radio grilles and knobs. This discussion is confined to the rigid type, which itself consists of a family of plastics with widely varying properties. Included in the ABS family are heat-resistant, high-strength grades and medium-impact, nylon-like grades. A major attraction of this material is its relatively low cost ($0.49/lb, $0.52/lb-vol.) in comparison with that of previously discussed plastics. Of the popular automotive engineering plastics, only the polyolefins are less costly.

Chief automotive interests center around the high modulus, high heat-resisting ABS, which simultaneously offers high surface hardness and high strength. Room-temperature modulus of this type is higher even than that of acetal. In comparison with nylon and acetal, these ABS materials have lower heat distortion temperatures at low load levels (66 psi) but higher heat distortion temperatures under high stress (264 psi). Interpreting this, under low stress levels, nylon and acetal are usable at substantially higher temperatures than ABS, but at high stress levels the reverse is true. Creep resistance of ABS is superior to that of nylon and comparable to that of acetal. ABS is relatively insensitive to moisture and in this regard is superior to nylon. These properties, coupled with relatively low cost, make ABS materials severe competitors with the more premium-

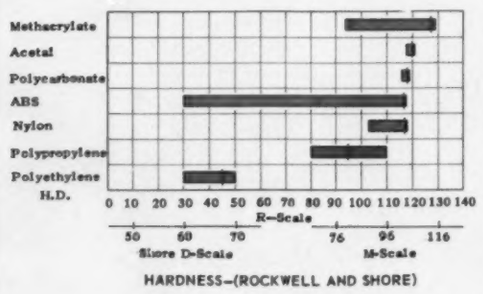
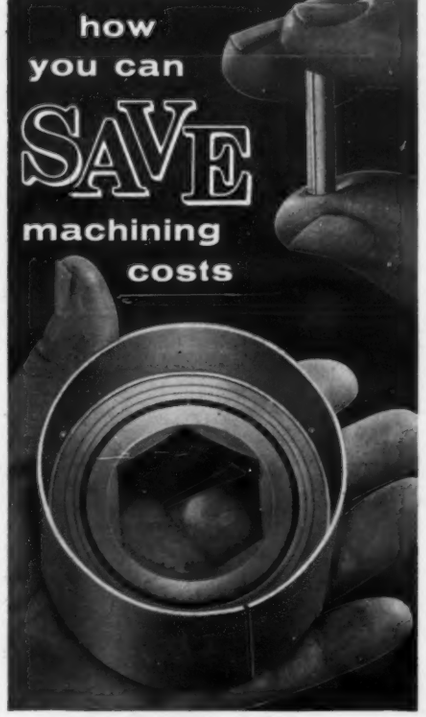


Fig. 6



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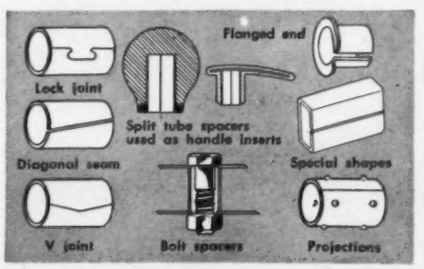

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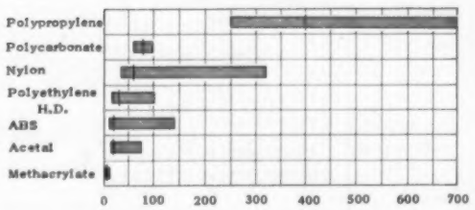

Fig. 7

priced polymers discussed earlier, and with the lower-cost polyolefins in applications for which the properties of polyolefins are borderline.

Current and potential usage of rigid ABS materials include cams, knobs and pushbuttons, instrument cluster housings, domelight bezels, radio grilles, electrical condenser housings, battery caps, accelerator pedals and possibly whole instrument panels. Blown ABS sheet with solid ABS outer skins (sandwich-type construction), already established in the boat building industry, is being considered for automotive use. ABS can be integrally colored, metallized or painted.

Polyethylene, H.D.

Polyethylenes are of three general types, classified by ASTM as: Type I, low density (0.910-0.925 g/cm³); Type II, intermediate density (0.926-0.940 g/cm³), and Type III, high density (0.941-0.965 g/cm³). In comparison with other polyethylenes, Type III offers higher rigidity, higher temperature resistance and better chemical resistance. Because of automotive requirements, this discussion is limited to high-density polyethylene with a current price of $0.35/lb , $0.33/lb-vol.

High-density polyethylene has a somewhat waxy feel with very low friction. Under some conditions of speed and load, it approaches that of tetrafluoroethylene. Polyethylene currently is under evaluation for lightly loaded, low-speed bearing applications to obviate the need for periodic lubrication. Its gasoline resistance and relatively low gas permeability suggest possible use in the fuel system.

In comparison with the other plastics described here, polyethylene is lowest in hardness, tensile strength and modulus. Under load, it is subject to creep and distortion. Consequently, it rates extremely low as a structural material. Likewise, its heat resistance is rather low. Expressed in terms of heat distortion temperatures, about 150F is its upper limit of serviceability at low stress levels (66 psi), and about 115F at high stress levels (264 psi). Under extremely low or negligible load, however, the maximum continuous service temperature exceeds 200F.

(Continued on next page)

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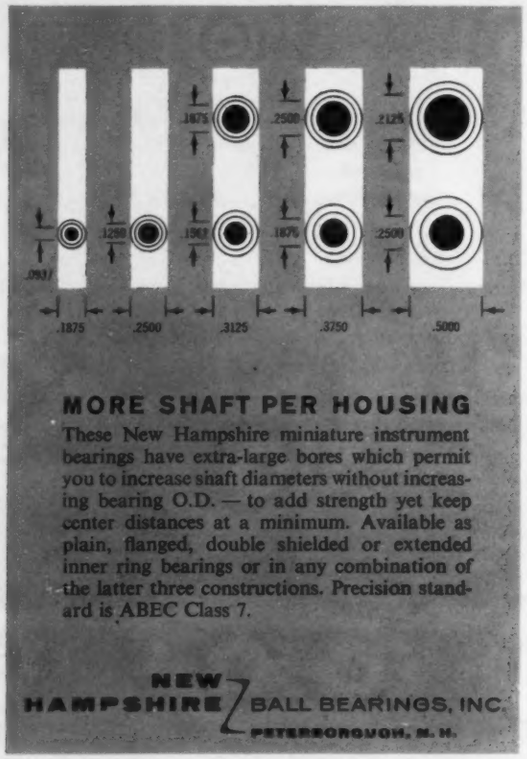
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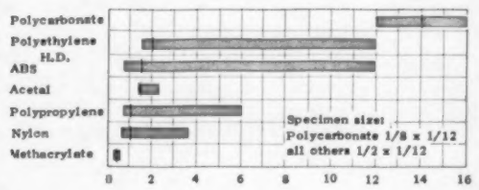

Fig. 8

Polyethylene also has extremely high coefficient of thermal expansion, nearly ten times that of steel and about twice that of certain ABS materials. Consequently, automotive components of polyethylene must be designed to permit a high degree of expansion and contraction with temperature change. Because of mold shrinkage characteristics, which vary with the orientation of the polyethylene molecules within the part, it is often difficult to produce and maintain large flat areas within a part, because of distortion upon removal from the mold and subsequent cooling.

Polypropylene

Polypropylene somewhat resembles high-density polyethylene in appearance. In physical properties it occupies a position between polyethylene and the higher-strength thermoplastics discussed above. Its tensile and modulus are somewhat higher than those of polyethylene, making it somewhat more structural in nature. It is twice as hard as high-density polyethylene and equal in hardness to many ABS materials, thereby having a fair degree of scratch resistance. A unique property of polypropylene is its resilience and high stretch characteristics. Elongations at break of 400 percent are not uncommon. This is much higher than that obtained on high-density polyethylene or on any of the premium-priced polymers. In addition, its flex life is exceedingly good. This combination of properties accounts in part for its unique ability to flex seemingly indefinitely in thin sections. A polypropylene injection-molded accelerator pedal with integral hinge soon will take advantage of this property.

Low-temperature properties of polypropylene are considered to be poor. However, this is largely because of its notch sensitivity. On a notched Izod specimen at −40F it shows practically no impact strength. Yet in the form of an accelerator pedal, the thin, radiused, hinge section flexes continually without damage at −40F. Thicker sections tend toward brittleness at low temperatures.

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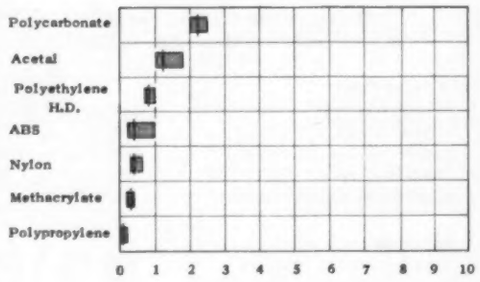


LOW-TEMPERATURE IMPACT STRENGTH (IZOD NOTCHED),-40 F

Fig. 9

Although most polypropylene is consumed in luggage, textiles and ropes, it now has established a foothold in the automotive industry. Current and potential applications are dome-light lenses, cable connectors, seat kick panels, upholstery, tubing, radio grilles and miscellaneous clips.

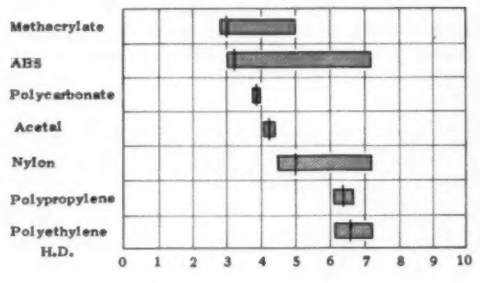
Polypropylene is only slightly more costly than high-density polyethylene ($0.42/lb, $0.38/lb-vol.).

Desired Properties

For Expanded Usage

Looking forward toward the use of plastics for additional automotive components, it is indicated that a new tack must be taken which requires a new family of "working plastics". The present materials are adequate for their current applications, but to take the next step and move into new areas requires improved physical and mechanical properties. If plastics are to step up to structural applications, they must meet more rigorous requirements in several important areas.

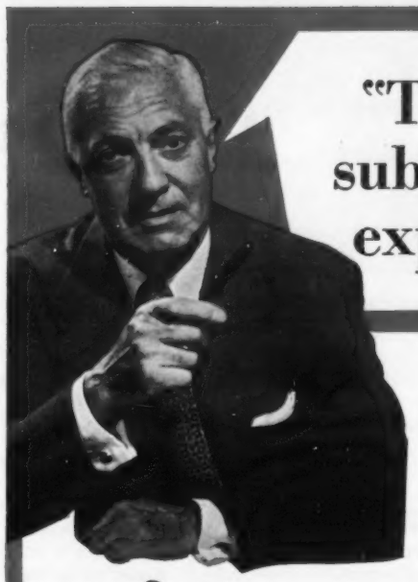
Heat resistance is an important consideration



COEFFICIENT OF THERMAL EXPANSION (10-5in/in/deg F)

Fig. 10

(Continued on next page)



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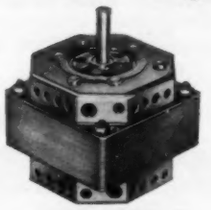

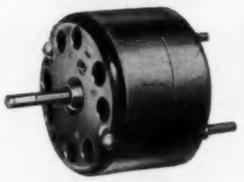

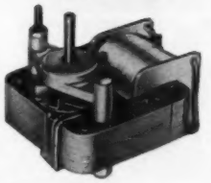

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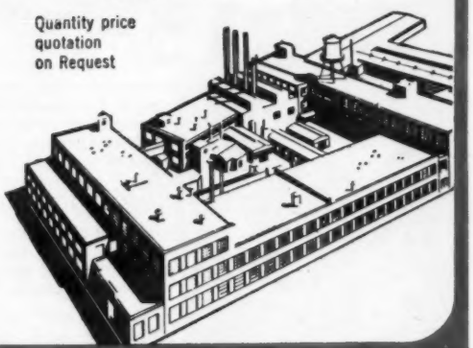

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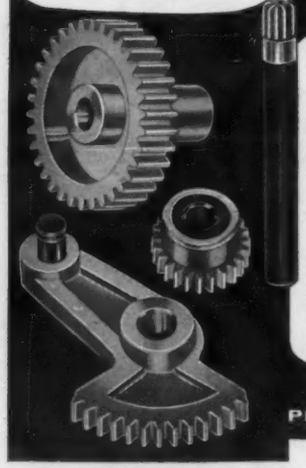

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Radiator top tank (surface)	240
Carburetor (air)	210
Master brake cylinder (surface)	210
Body Interior	
Visor behind W/S (surface)	215
Padded instrument panel (surface)	220
Front seat cushion (surface)	185
Seat side shield (air)	160
Steering wheel (surface)	175
Rear floor (air)	160
Headlining at dome light (air)	165
Inner door space (air)	155
Accelerator pedal (surface)	130
Body Exterior	
Top (surface)	165
Side panel (surface)	150
Hood (surface while driving under load)	170

Fig. 11

since vehicle components are exposed to a variety of temperatures from −40 to 240F. The elevated temperatures encountered in desert operation at ambients up to 125F are shown in Fig. 11. In order to provide adequate properties for structural use, materials must be developed which have superior properties and are able to maintain them at temperatures up to 250F.

Conclusions

Activity in the development of automotive plastic components has never been higher. But this development pace must be quickened. We are not yet taking full advantage of the combination of superior material properties and cost that the plastics industry is offering. Imagination, creativity and sound engineering must be applied in the design of automotive components, based upon the unique and peculiar properties of the plastic materials and without restriction to former configurations and design concepts.

Abstracted from technical paper No. 381A; $1; to SAE members, $0.75. Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N.Y.

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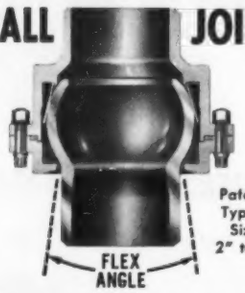

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TECHNIQUES FOR OPTIMIZATION OF A FINNED-TUBE RADIATOR:

L. H. Schreiber, R. P. Mitchell, G. D. Gillespie and T. M. Olcott, Convair-Fort Worth, A Div. of General Dynamics Corp.; ASME No. 61-SA-44; $1; to ASME members, $0.50.

Provides a method of optimizing, for the maximum Q/W, a rectangular cross-sectioned fin for use on a space radiator, considering the effects of both fin and tube. Data required for calculations are presented in graphic form. Comparison is made of beryllium, aluminum and copper fins on beryllium and steel tubes. Consequences of meteoroid protection devices are discussed.

AUTOMATION OF LOGIC PAGE PRINTING:

C. R. Warburton, International Business Machine Corp., Poughkeepsie, N.Y.; AIEE No. CP 61-726; $1; to AIEE members, $0.50.

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EXPERIMENTAL RESULTS OF A CRYOGENIC HEAT EXCHANGER:

William F. Chew, Norair Div., Northrop Corp., Hawthorne, Calif.; ARS No. 61-189-1883.

Primary criteria for the design of a cryogenic heat exchanger are the thermal resistances combined as an overall coefficient of heat transfer. This paper deals with the empirical evaluation of a specific cryogenic boiler to determine overall coefficient of heat transfer for the forced convection of nitrogen gas.

DISCUSSION OF STEERING PROBLEMS ON MODERN HEAVY TRUCKS:

T. I. Monroe, Ross Gear & Tool Co., Inc.; SAE No. 368A; $1; to SAE members, $0.75.

Centerpoint axle designs have an appreciable effect in reducing wheel efforts for vehicles in motion. Power steering further reduces efforts and wheel turns. There appears to be no benefit in combining centerpoint axle with power steering. In the final analysis the customer will probably decide on relative merits of centerpoint steering versus power steering, basing his decision on such factors as original cost, comfort, safety and maintenance costs.

TORSION OF SANDWICH PLATES OF TRAPEZOIDAL CROSS-SECTION:

Shun Cheng, Dept. of Mechanics, University of Wisconsin, Madison, Wis.; ASME No. 61-APM-22.

A system of suitable stress-strain relations as well as equations of equilibrium are derived and solved for the torsion of sandwich plates of trapezoidal cross-section. Facings are treated as isotropic solid membranes of equal thickness while the core is of such a nature that its stiffnesses associated with plane-stress components are negligible.

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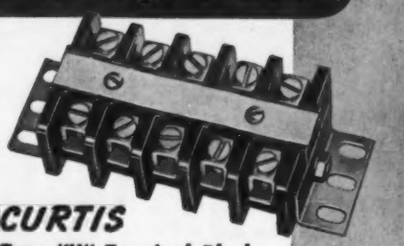

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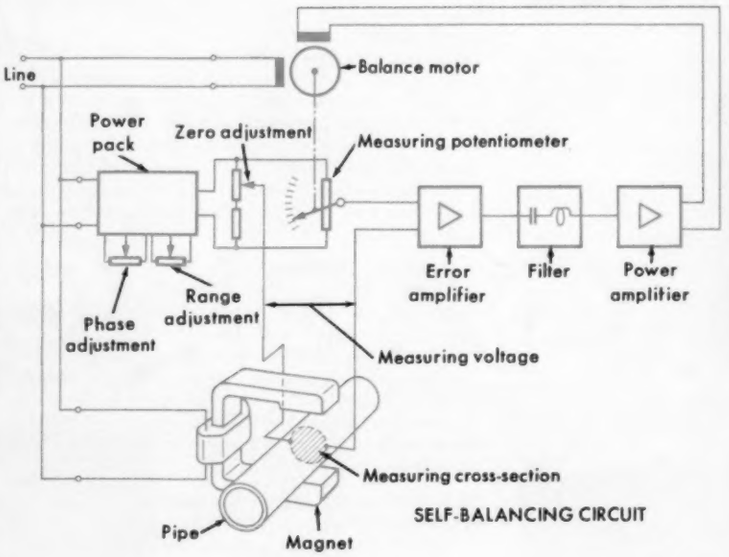
DESIGN IDEAS NEWS

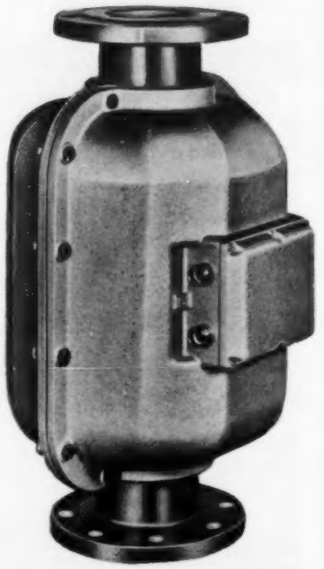
CONTROLS

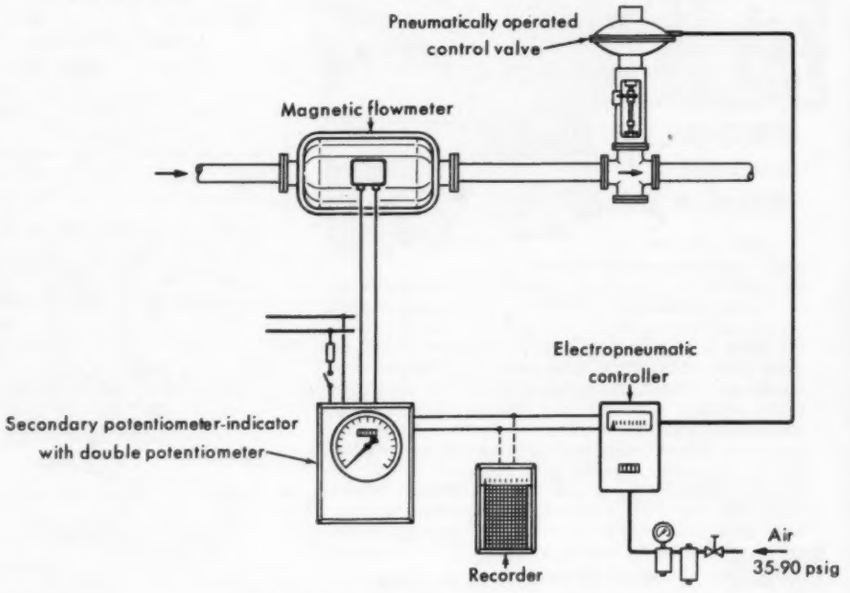
Magnetic Field Measures Flow Rate

R. F. Stengel, German Editor

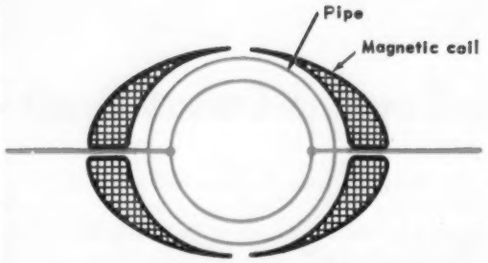


SELF-BALANCING CIRCUIT





FLOW-CONTROL LOOP



MAGNETIC COILS AND MEASURING CROSS-SECTION

A fluid flowing through a magnetic field induces a voltage proportional to the mean flow velocity and the magnetic field strength. Two electrodes, mounted flush with the insulated pipe wall, pick up the induced voltage which is amplified, recorded and used to control the flow rate.

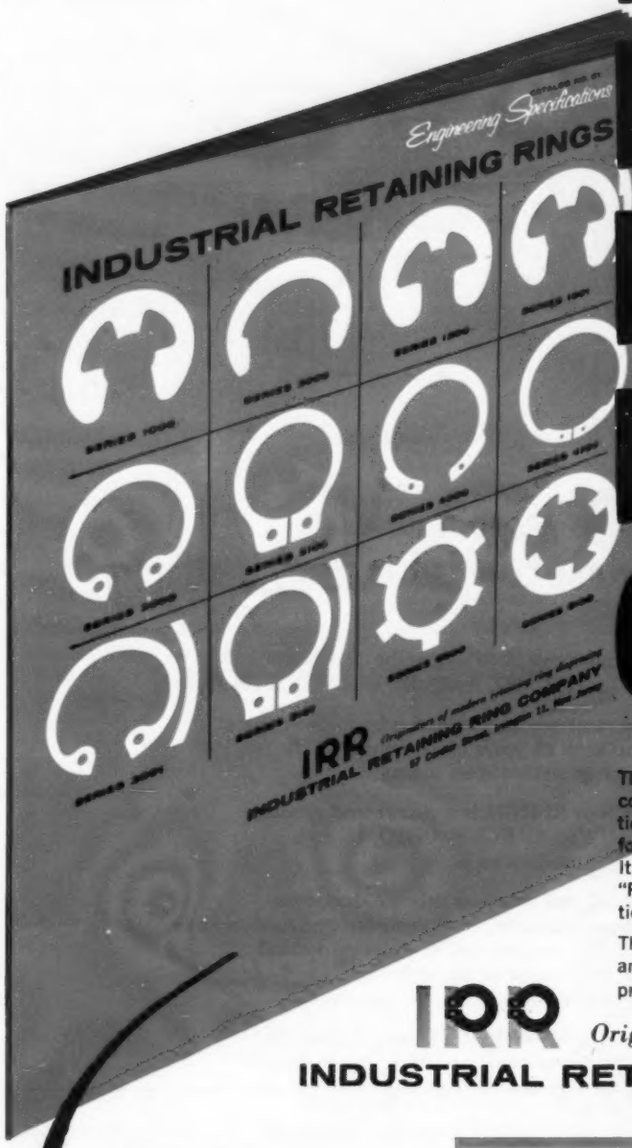
The new magnetic flowmeter has several advantages over conventional flowmeters. Operation is independent of pressure, temperature, concentration and viscosity. Since the field is homogeneous, the flow regime (laminar or turbulent) has no effect on readings; no straightening section is required and the meter can be installed directly downstream of valves or bends. As flow takes place in a straight section, constriction losses are eliminated. Unlike orifice or pitot devices, the magnetic flowmeter reads linear with flow rate, making square-root extraction from differential pressures unnecessary.

Insulating materials for the measuring pipe section are rubber, acid-resistant enamel, "Teflon" or fiber-glass-reinforced plastics. The magnetic coils have a cross-section bounded approximately by an ellipse on the outside and a circle on the inside to achieve field homogeneity. Available meter sizes range rom 2 to 750 mm nominal dia, depending on application.

Magnet and measuring potentiometers are fed from an a-c line voltage. Phase and amplitude of the potentiometer voltage are adjusted in accordance with phase and amplitude of the induced voltage. The difference between induced and potentiometer voltage is amplified and used to balance the potentiometer through a balance motor. This arrangement eliminates errors caused by changes in line voltage, frequency or ambient temperature.

The output of the potentiometer-indicator is fed to a strip recorder and an electropneumatic controller, which adjusts a pneumatic control valve. The magnetic flowmeter is a product of J. C. Eckhardt AG, Stuttgart-Bad Cannstatt, Germany.

For YOUR File . . . **New! Industrial Retaining Ring Catalog**



This new Industrial Retaining Ring Catalog, No. 61, contains complete information and engineering specifications on IRR Internal and External Retaining Rings—both for axial and radial assembly—from sizes .040" to 4.125". It also has information of the exclusive, time-saving, IRR "PRE-STACKED" Axial Assembly Rings as well as information on IRR Pliers and Accessories.

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Sequence-Control Circuit

Kurt F. Kircher, Managing Editor

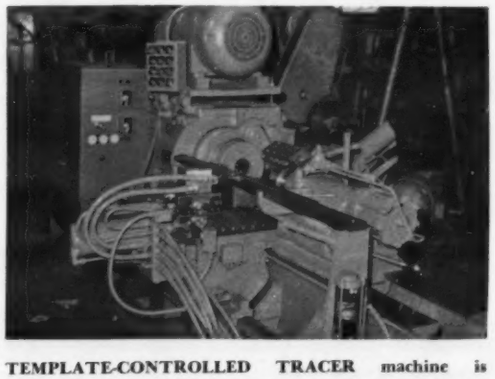
A multicycle, sequence-control hydraulic circuit in a tracer-controlled machine tool permits the machine to take a number of progressive cuts when regular single cuts will not accomplish sufficient reduction in stock size. Only one template that controls the configuration of the finished part is required. The sequencing system automatically provides the successive passes required to bring oversized stock to finished size.

The machine is operated hydraulically. Hydraulic force holding the tracer in contact with a template provides the primary signal for the circuit. Hydraulic cylinders move both the tool carriage and cross slides. Motion control cylinders are cross-connected so both are loaded at all times, whether taking longitudinal, cross or diagonal cuts.

The hydraulic control system provides repeat accuracy of ±0.0003 inch on both face and axial cuts, making the machine suitable for both rough and finish work.

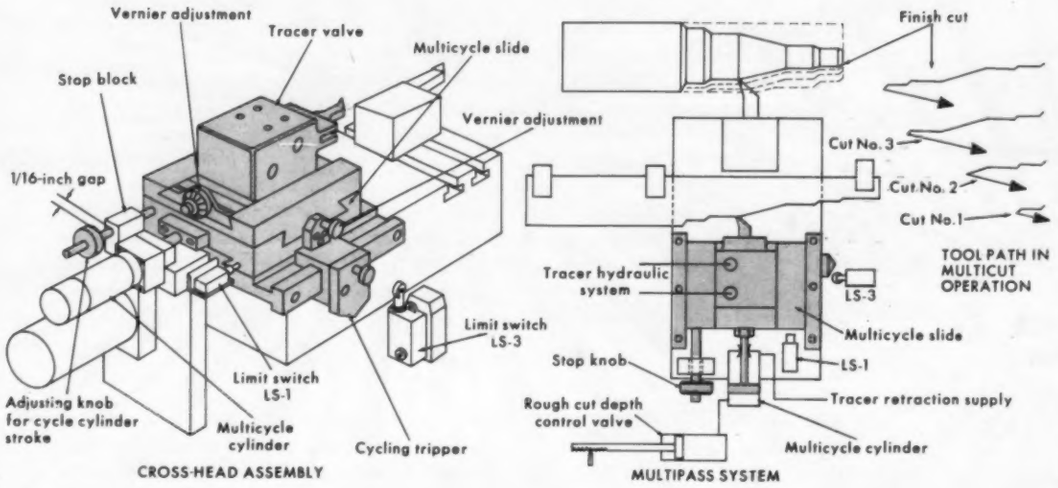
The tracer machines are built from existing machine tools by a construction-conversion process. The tracer control system is a basic part of the new machine and not an accessory.

The machine design and construction work is done by the Bald Mountain Machine Co., Pontiac, Mich.

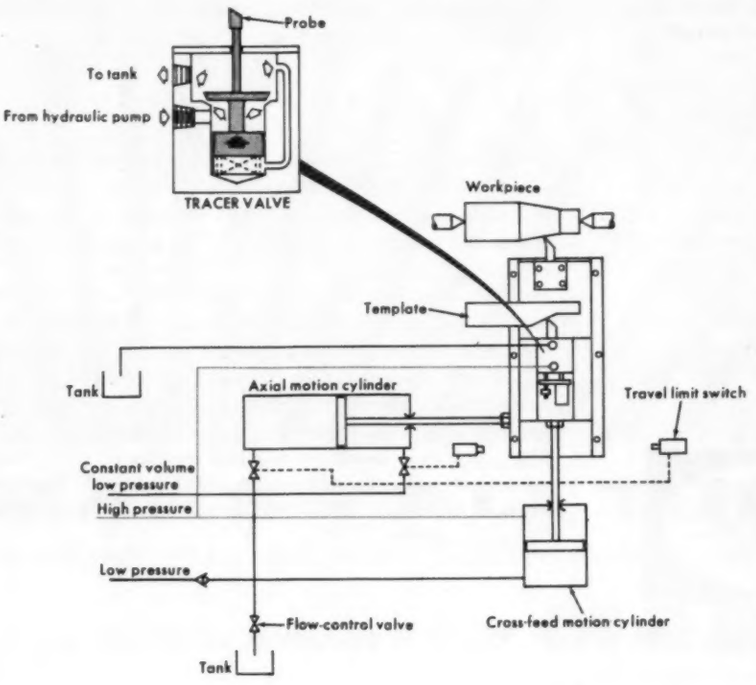


TEMPLATE-CONTROLLED TRACER machine is equipped with cross slide carrying tracer probe and tool on carriage plus multitool in-feed head at rear. Machine is basically high-production unit but is immediately adaptable for short runs. Change of set-up requires only exchange of template, setting of carriage-travel limit switches and adjustment of multicycle sequence control establishing number of passes to be taken to cut stock to finished size.

Gives Tracer Machine Multipass Ability



MULTICYCLE OPERATION is signalled by relative positions of tracer probe and tool bit. Amount of stock to be removed on diameter is determined and cycle cylinder stop knob is backed off part of this distance. Depth of roughing cuts is set on depth-control valve. Multicycle cylinder moves tracer probe toward tool until stopped by stop knob. Depth-control valve and cylinder advance circuit then are locked electrically. On start, contact of probe and template controls carriage movement. When cross slide backs off sufficiently to trip LS-3, carriage returns to start position. Depth-control valve absorbs measured volume of fluid from cycle cylinder, causing tool to advance with respect to tracer. Cut operation then repeats. On final pass tracer is in full back position, tripping LS-1.



SINGLE-FLOW CONTROL VALVE regulating flow out of closed end of carriage-motion cylinders controls motion of tool. Tracer valve is poppet-type, controlling high-pressure line dump. Valve is fully open until probe contacts template. On cycle start, low-pressure force in cylinders moves probe toward template, high-pressure line being vented. Contact of probe and template throttles high-pressure dump, providing feed motion in cylinders. Closed ends of both cylinders dump through common flow control valve.

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NEW BOOKS

LIFE PICTORIAL ATLAS OF THE WORLD illustrates the universe, the earth and the continents in three-dimensional "Global Views" as they would appear from outer space. The book contains 600 pages (440 in six colors) and a 160-page gazetteer-index which locates more than 75,000 places. Also included are up-to-date available population figures for all foreign countries and cities. The 1960 census figures are given for all U.S. cities having more than 1000 population. For each continent, for Canada (each province) and for the U.S. (every state) there are terrain, political and economical maps showing cities, towns, physical features and other important data. Terrain maps illustrate certain features shaded in depth, giving them a three-dimensional effect. The concept of this technique makes the maps easily read and understood. Greatest value of this atlas is the fact that all information concerning a particular area can be found in one place. Not only of interest to libraries and businesses, the book also is an aid to any individual who wants a broader understanding of this world we live in. By the editors of "Life" Magazine and Rand McNally; Rand McNally & Co., 124 W. Monroe St., Chicago 3, Ill.; $30 regular edition ($35 for deluxe edition).

THEORY OF HYDRODYNAMIC LUBRICATION deals with the broad field of hydrodynamic and hydrostatic lubrication. By applying the general principles of fluid flow to bearing operation, Oscar Pinkus and Beno Sternlicht formulate the differential equations of lubrication, including energy and elasticity considerations. The book also presents solutions to these equations, either analytically or by analog and digital computer. The equations presented provide a basis for the design and solution of specific bearing problems. Specific areas discussed in the book are incompressible lubrications; gas bearings; hydrostatic bearings; squeeze film; dynamic loadings; variable viscosities; elasticity; rolling elements; inertia and turbulence; non-Newtonian fluids and extensions of classical theory. A discussion of experiments which support the theory provides a link between theory and practice and aids in the comprehension of the subject matter. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N.Y.; 465 pages; $15.

CYBERNETICS, or "Control and Communication in the Animal and the Machine", second edition. The first edition of "Cybernetics" in 1948 started a whole new branch of science and was really the basis for much of our present thinking on computers and control systems. Norbert Wiener, long a professor of mathematics at M.I.T., coined the word "Cybernetics" from the Greek root of our word "governor" to indicate the feedback function. This new edition contains the entire original edition with corrections, plus two supplementary chapters on learning and self-reproducing machines and on brainwaves and self-organizing systems. The two new chapters bring into focus the effect of the intervening 13 years on the field of the communication sciences. This new version is certain to become as much of a classic as the original; certainly the addition of further chapters has made "Cybernetics" an even more fascinating book. The publication should be required reading for every engineer for its philosophical content as well as for its precepts and theories. By Norbert Wiener, The Technology Press of M.I.T. and John Wiley & Sons, Inc., 440 Park Ave. S., New York 16, N.Y.; 222 pages; $6.50.

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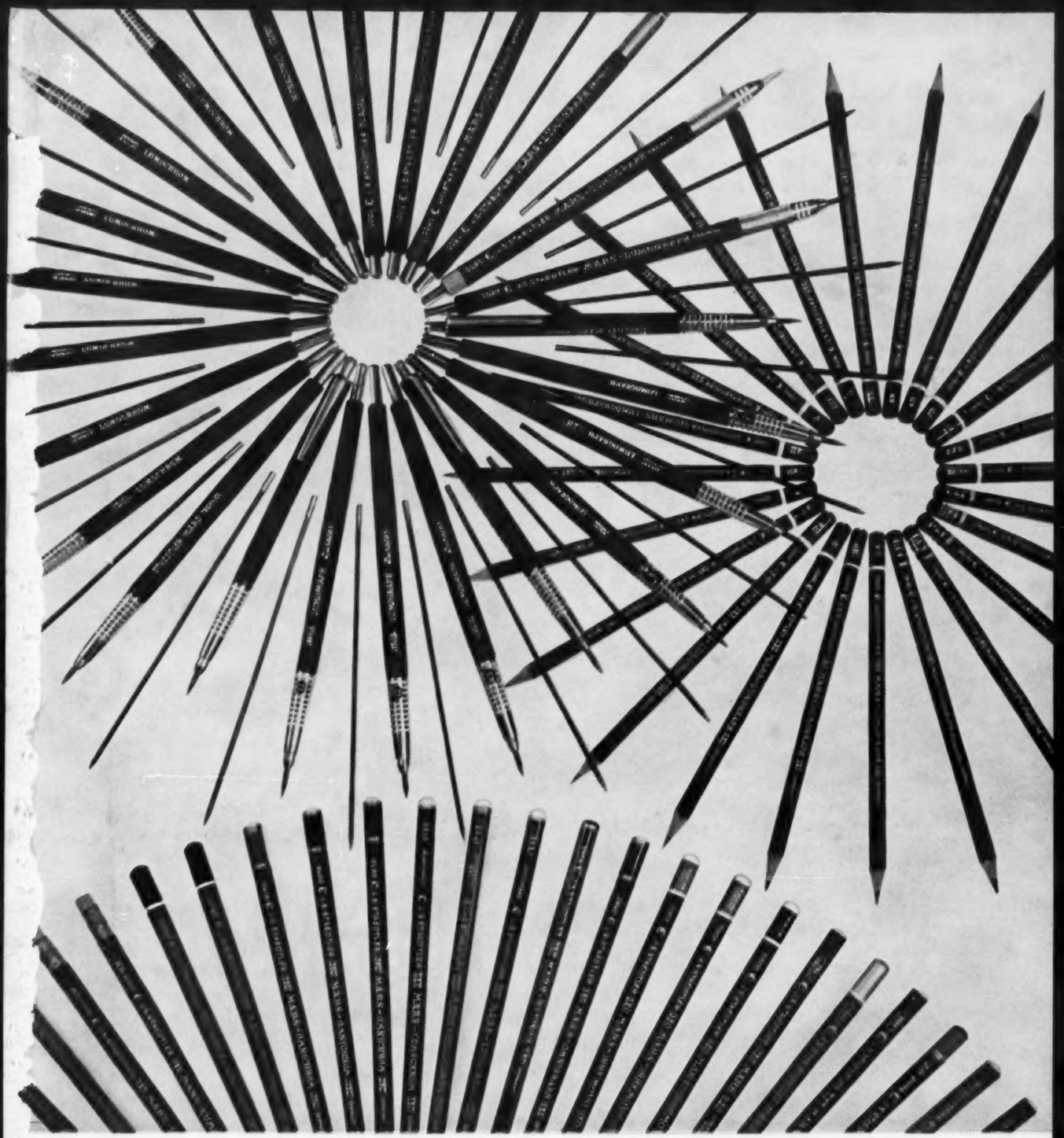

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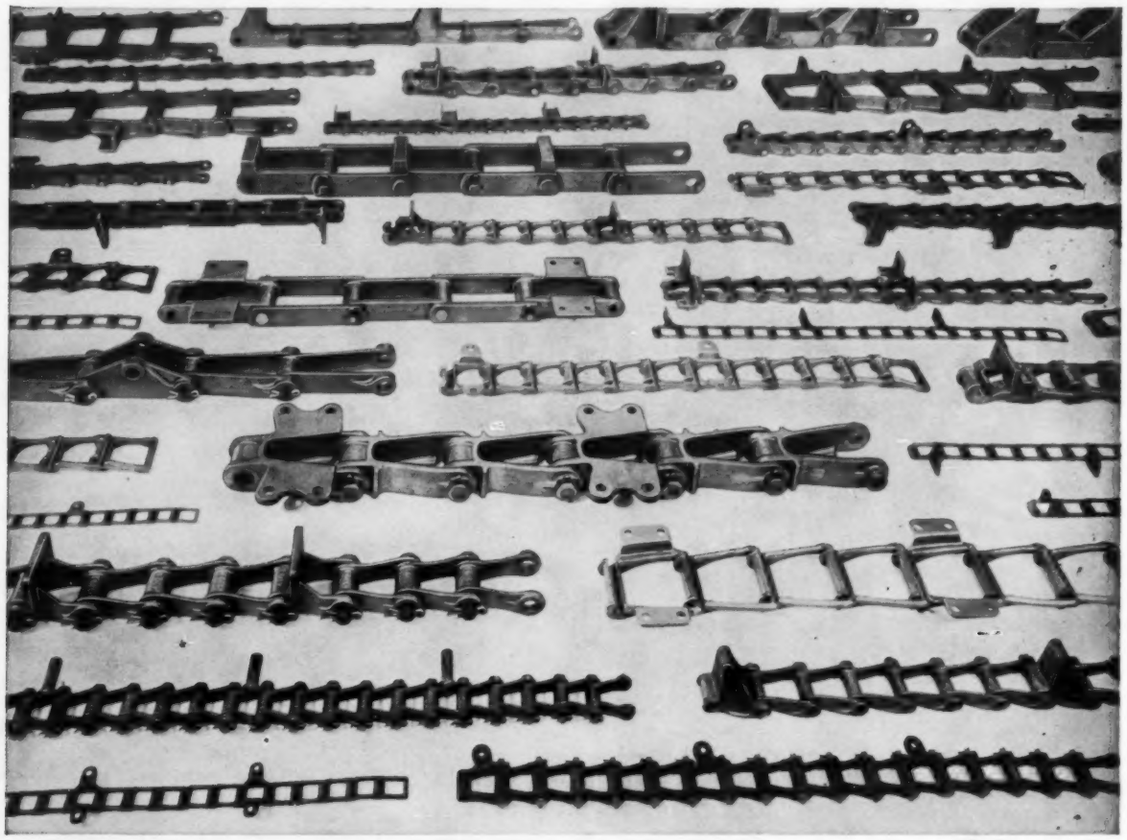

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THEORY OF MACHINES in two parts is a very thorough treatment of the entire field of mechanisms and dynamics. Part I, entitled "Kinematic Analysis of Mechanisms", is a complete text and reference carried through analog computing mechanisms. This part of the book includes all of the usual mechanism trains, as well as separate analysis on gears, linkages and cams. Part II is a text on dynamics, which requires some knowledge of differential equations. The entire book comes nearly as close to being a complete course in machine design as it is possible to get within one volume. By Joseph Edward Shigley, McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N.Y.; 658 pages; $11.50.

DESIGN OF MACHINE ELEMENTS, Third Edition. The first edition of this book was published in 1948. The up-dating of this third edition, combined with the enlarging and changes of the second edition, combine to provide simplification and streamlining of well-established analytical techniques used in the design of machine elements. Chapters one and two are titled "Fundamental Principles" and "Working Stresses". Chapters three through twelve cover machine elements by type. The last two chapters cover "Dimensioning and Details" and "Engineering Materials". Although intended as a college text, this book should be a valuable, up-to-date reference source for mechanical design work. By M.F. Spotts, Prentice-Hall, Inc., Englewood Cliffs, N.J.; 574 pages; $13.35.

ENGINEERING-TECHNICAL DRAFTING AND GRAPHICS is a nice compromise between the usual textbook and the industrial approach to drafting. The format itself is of interest because it is large enough to use large drawing examples. Photographs are used extensively to illustrate modern products which are used as examples in drafting. The book is intended for training in problem solving. More than a drafting book, the publication is a course in basic design including descriptive geometry, tool drawing, patents and methods of reproduction. Also included is an interesting chapter on developments and intersections of piping and similar structures. Graphs and charts are provided, although not in very great detail. By J.W. Giachino and Henry J. Beukema, American Technical Society, 848 East 58th St., Chicago 37, Ill.; 778 pages; $9.75.

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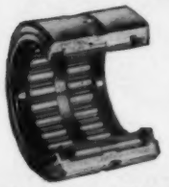

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Results of Brake Equalizer Tests

BRAKE EQUALIZER TESTS show that unit does not meet originally reported stopping distances (DESIGN NEWS, June 5, 1961, pages 12 and 13). Tests conducted by Frank Abell, Traffic Safety Service, Inglewood, Calif., on the Do-Mor Brake Equalizer, when installed on a 1961 low-mileage Chevrolet Impala, indicated that the equalizer may be instrumental in extending the time that skids start, yet the device does not delay the brake application.

Fractions of a second are major increments when conducting panic stops from high speeds. For example, it takes from 0.12 sec to 0.31 sec for the stop light on a vehicle to reach an intensity so that it can be seen by a following driver.

Tests were conducted at speeds from 30 to 70 mph in increments of 10 mph. It was unsafe to conduct tests at higher speeds because the new Impala (23 miles on speedometer at start of test) was not equipped with safety belts or other protection equipment.

There were consistently shorter tire skid or brush marks when the equalizer was in operation. The rate of deceleration was greater with the equalizer in operation than without.

Up to 50 mph, the vehicle speed was taken from a fifth wheel arrangement. At 60 mph and 70 mph, vehicle speed was computed from photographs made by a chase car. Detonators, firing chalk marks on the track of the Riverside International Raceway, marked the point of brake application and the point vehicle deceleration reached 6.4 ft/sec² during the panic stops.

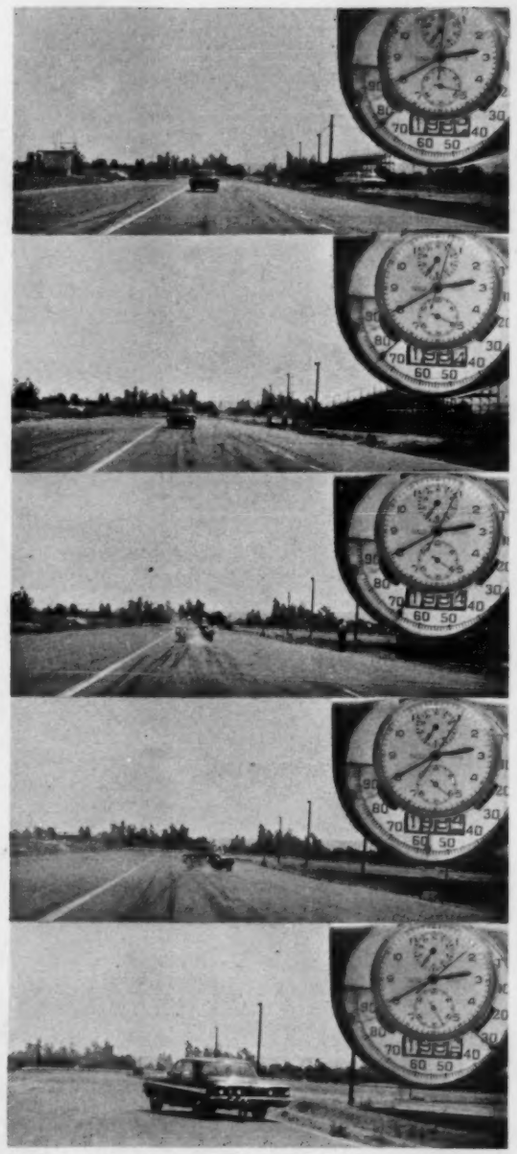
E.W.S.

	Speed MPH (corrected)	Stopping distance ft	Deceleration ft/sec²	Skid or brush marks ft	Distance to reach 6.4 ft/sec² deceleration ft	Time for smoke of tire skid to appear sec	Brake drum temp. (highest value of 2 front wheels) deg F
	76	291.5	21.31	Not measured due to length and track condition	18	2.56	190
*	72	230.3	24.21		17.8	2.75	135
	70	287	18.36		13.5	3.00	220
*	70	233.2	22.60		10.3	2.31	180
	60	195.5	19.81		22.8	data incomplete here	110
*	60	154.5	25.06		12.5		110
	60	172	22.51		10.5		140
*	50	96	28.01	66			120
	50	135	19.92	75	Data not taken here		140
*	40	92	18.71	42			120
	40	95	18.12	63			120
*	30	52	18.62	31			100
	30	52	18.62	40			100

Track was asphalt with estimated coeficient of friction of 0.7

* Brake equalizer 'on'

ABBREVIATED TABULATION of test results. Asterisk indicates equalizer in operation. Ambient temperature was 89 to 91F. Cross wind moved from right to left and varied 5 to 8 mph, with all tests made in the same direction on track. Speeds at 60 mph and 70 mph are corrected by computation from photo instrumentation in chase car.



SAMPLE FILM from camera in chase car. Speed of chase car is shown on outer meter. Actual speed of vehicle under test can be computed by change in image size in relation to speed of chase car. Clock provides elapsed time in seconds between individual frames or accurate computation of film speed which is approximately 16 frames per second.

Redesign of Marine Stabilizer Reduces Sealing Problems

Redesign of a marine stabilizing fin shortens the entire unit enough to permit complete enclosure by a housing in the retracted position. Sea water circulates through the housing, and since the main shaft does not protrude into the hull, a major sealing problem is eliminated and cargo space is gained.

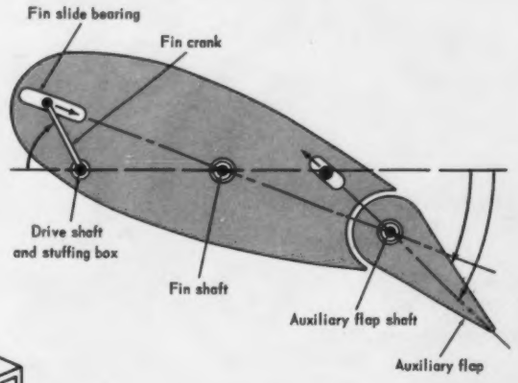
The new design requires only a small stuffing box for the fin driving shaft, which has rotational motion only. The forged-steel main shaft has two fixed shoes moving in slideways attached to the fin housing. The fin is extended and retracted along these slideways.

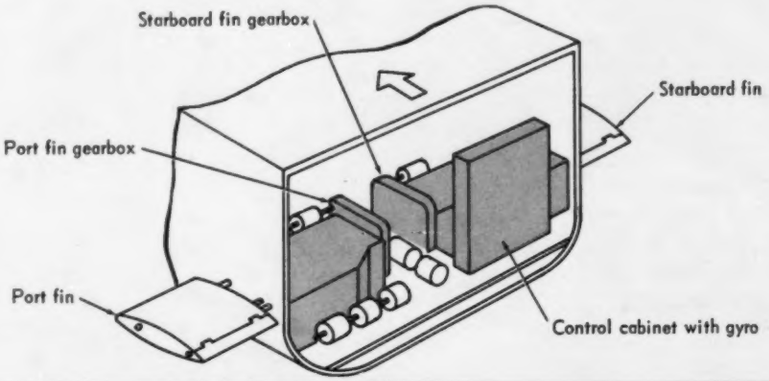
The fin mainshaft is hollow and accommodates a hydraulic piston and piston rod for extending or retracting the fin. The hydraulic system is fed from a self-contained pump. When retracted, the fin is locked automatically in neutral position. During transverse movement, which lasts about two minutes, the fin is released. When fully extended, the fin is engaged and starts to compensate rolling motion of the ship.

All bearings are plastic and lubricated by sea water. All drive elements exposed to sea water are made of chromium-alloy steel. The use of steel and plastic only prevents electrolytical corrosion.

Fin operation is fully automatic. "Out" pushbutton initiates unlocking and transverse movement. After fins are fully extended, an electrical control system takes over. Gyros sense rolling motion and generate an electrical output signal which is amplified. The fin motor is controlled through a Ward-Leonard set. Actual fin position is fed back for error correction. "In" pushbutton shuts down the control system and retracts and locks the fins.

The control system is a development of Siemens-Schuckertwerke AG, Erlangen, Germany; mechanical components were designed and produced by Blohm & Voss AG., Hamburg, Germany. **R.F.S.**





♦COMPACT INSTALLATION is made possible by narrow, stubby fins, shown here in "out" position. Space between shallow gearboxes contains only transformers, leaves passageway. Drive motors are mounted forward of fin housings; housing width aft is used to locate Ward-Leonard set, two drive motors, control cabinet with gyros, amplifiers and mixers.

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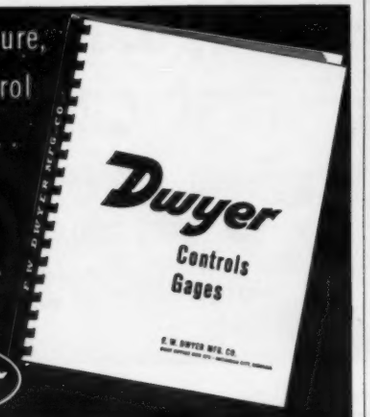

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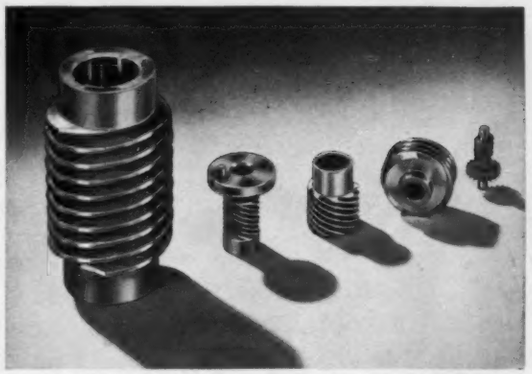

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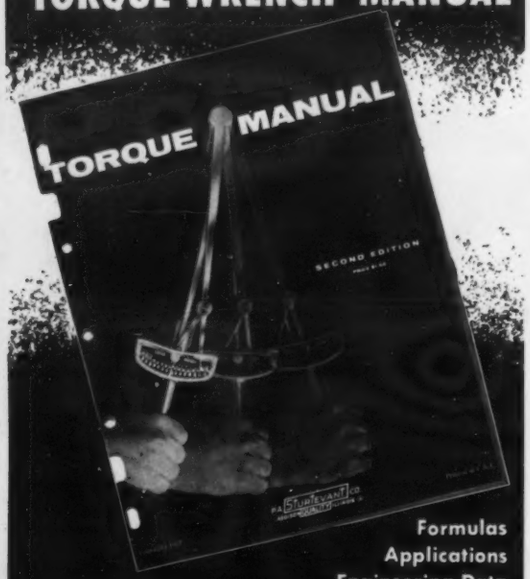
"TORQUE WRENCH" MANUAL



SENT UPON REQUEST

Formulas
Applications
Engineering Data
Screw Torque Data
Adapter Problems
General Principles

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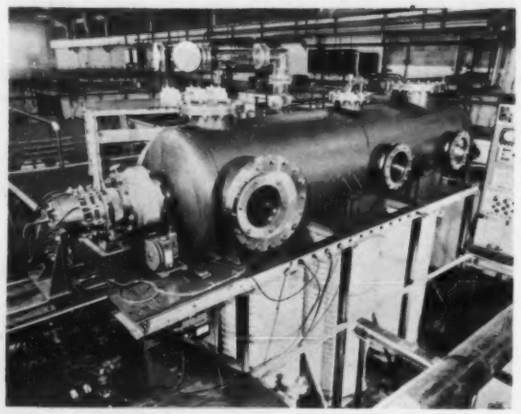
IDEAS IN THE NEWS



REPPAC III plasma propulsion engine (left foreground) attached to vacuum chamber.

• **REPETITIVELY-PULSED PLASMA PROPULSION ENGINE** (REPPAC III) has been fired continuously for 60 hours at the rate of 1000 firings a minute. It is believed to be a record for this type of device.

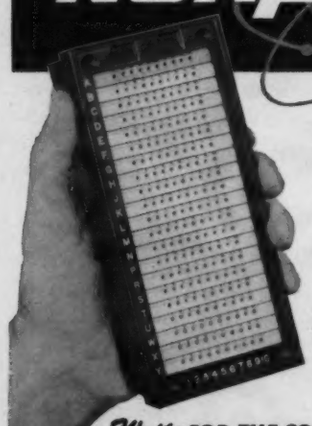
The engine was run in a 13-ft vacuum chamber that maintained a pressure of 5×10^{-6} mm of mercury. There was no interaction between the plasma exhaust and the residual gas in the test chamber. The engine produced 20 millipounds of thrust with a specific impulse of 5000 sec. It used 7 kw of power and operated at 32 percent efficiency.

An examination of the firing chamber showed no appreciable electrode erosion. The system appeared capable of operating long enough for a space mission of at least a year.

The firing chamber is the region between two concentric, cylindrical electrodes. An electrical potential is applied between the electrodes. As a steady trickle of argon gas flows out from holes in the inner electrode, it becomes ionized in the electric field. The resulting discharge current creates a magnetic field which drives the ionized particles out of the engine and into the vacuum. This cycle is repeated 1000 times a minute.

REPPAC III was developed by General Electric.

SQUARE D
announces
NORPAK



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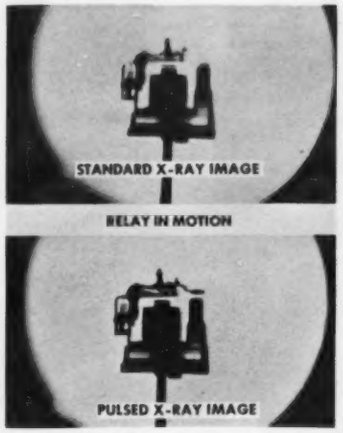


• **MULTIPLE-PULSE X-RAY SYSTEM**, used for environmental test studies, is capable of charting the performance of totally enclosed moving parts.

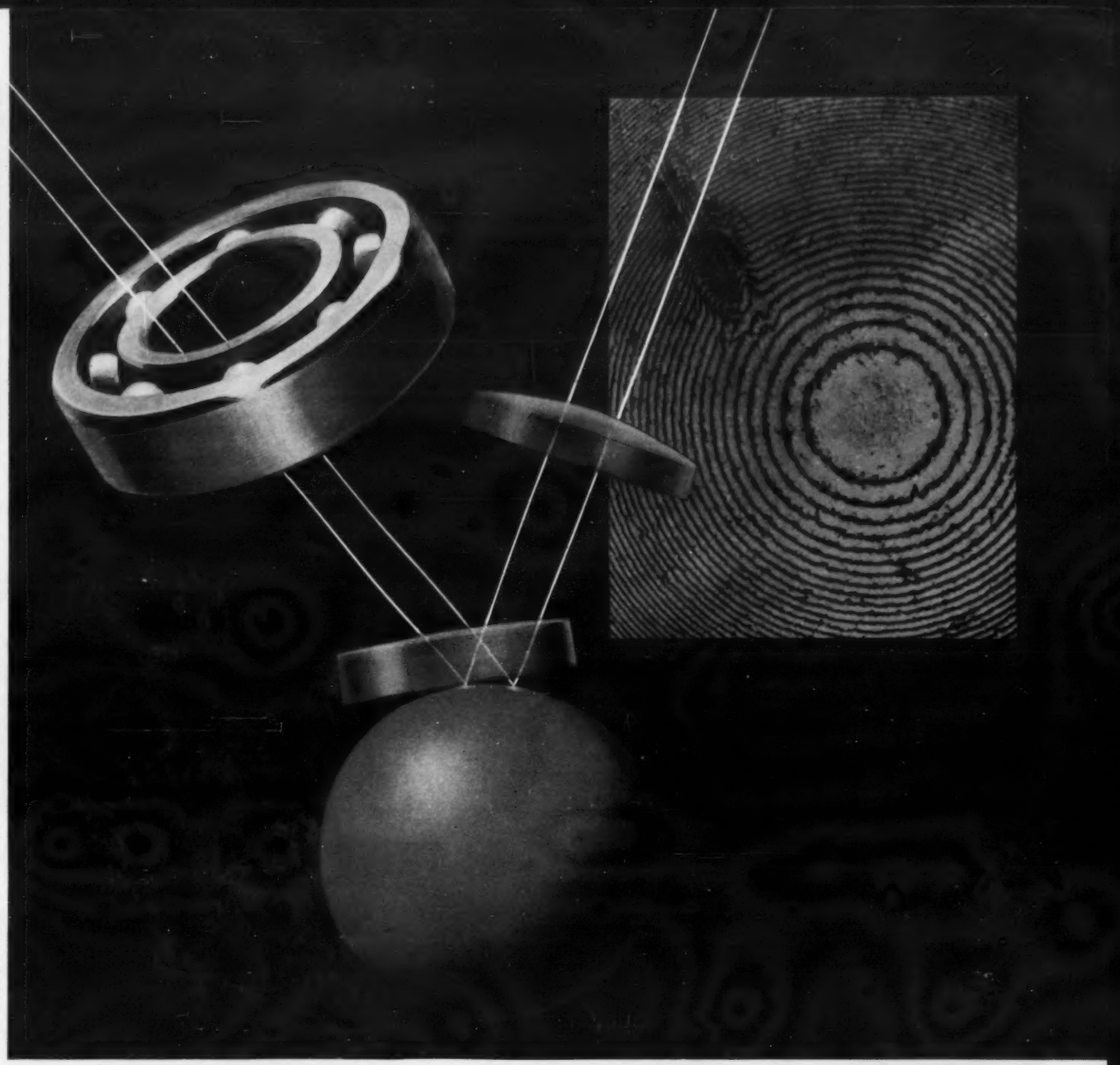
The pulsed X-ray system is based on the fact that vibration test studies do not require an immediate, continuous sequence of pictures. By shutting off the X-ray source between exposures, the X-ray tube target has a chance to cool. This cooling procedure permits an increase in the X-ray energy per pulse without damage to the target. The bolstered source intensity is powerful enough to penetrate the test specimens and produce sufficient film density in 1 μsec.

The system has a capacity of 30 pulses per second. This permits specimen studies over wide frequency and velocity ranges. Results are recorded permanently on film. The number of exposures can be regulated to suit the purpose of the test.

Application of multiple-pulse X-ray testing to any specific environmental project depends upon such factors as the test specimen material, material thickness, test environment and information required from the test. Such electronic components as relays, switches, connectors and tubes are considered well suited for this method. Larger objects also can be tested and the system can be utilized to perform studies in depth on such items as engines, power sources and related gear.

The system was developed by Zenith Radio Research Corp.

Circle 160 on Reader-Service Card



SPLIT LIGHT BEAMS MEASURE IN MILLIONTHS

to help SKF build better bearings

SKF MOTION ENGINEERING

Advanced ball and roller bearing technology

The concentric pattern of interference fringes in the picture above is reproduced from an actual photo taken with the aid of an interferometer in the SKF laboratories. The subject under examination is a microscopic flaw in the surface of an accurately lapped steel ball. The principle of utilizing split beams of light to form interference patterns enables accurate measurements to be made in *millionths* of an inch.

SKF is a leader in the development and application of ultra-precise measuring systems. The SKF metrology laboratory plays an important part in a continuing program of research to produce bearings of improved accuracy and finish, and consequently, quieter, smoother running characteristics.

Whatever types of rolling contact bearings you need—ball, cylindrical roller, spherical roller, tapered roller or precision miniature—you'll find SKF your best assurance of dependable performance. SKF Industries Inc., Philadelphia 32, Pa. 6104

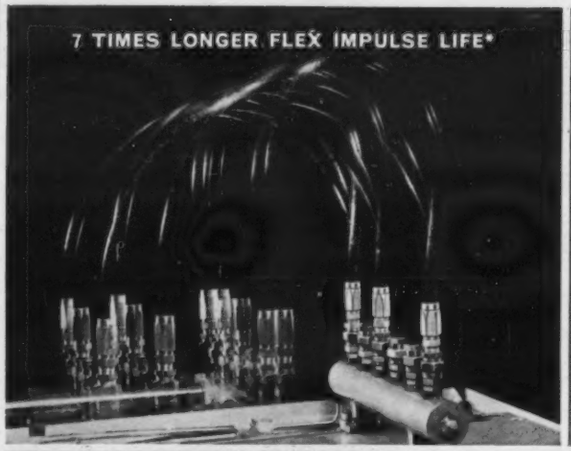
• **IRON SHELL**, identical in size and shape to the new Series F Atlas intercontinental ballistic missile, is being used to test silo launcher mechanisms at Vanderberg Air Force Base, Calif. Called "Water Bird", it has a capacity of 28,000 gal of water. The underground silo emplacement for the Series F Atlas is 174 ft deep and 52 ft in dia.

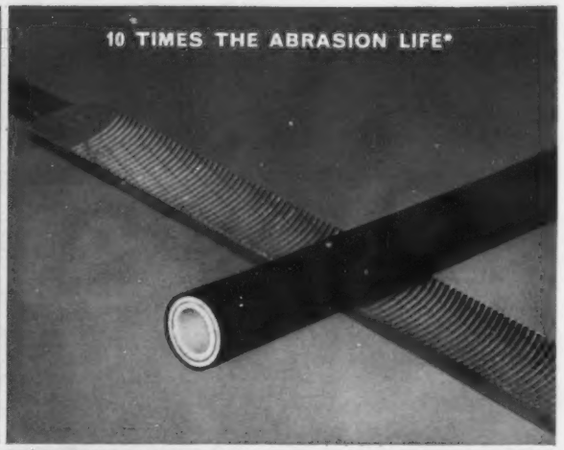
The Water Bird replica of the Atlas is lowered into the silo. Then water is pumped into it, providing the same weight distribution as a fully fueled Series F missile. The tests will determine that silo equipment specifications meet exacting tolerances. Two systems, electrical and launch platform drive, will be put through a series of operations to establish whether they function dependably under prescribed circumstances.

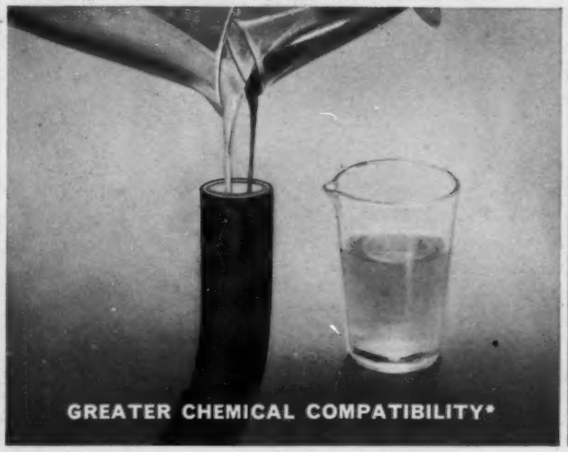
The electrical system receives and transmits information and commands between the missile and nearby blockhouse.

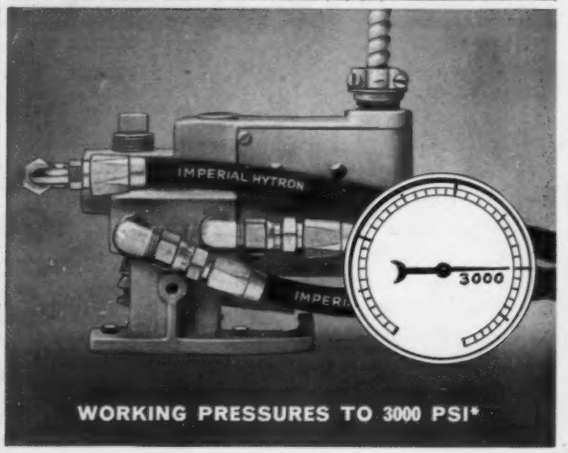
The launch platform drive system lifts the fueled Atlas to ground level. Tests include determination of the accuracy and dependability of the launch platform balance. In addition to tests, the Water Bird will provide realistic training for Strategic Air Command launch crews before they are assigned to operational bases.

The Atlas F is produced by Convair (Astronautics) Div. of General Dynamics, San Diego, Calif. It is about 80 ft tall and the propellant tank structure is 10 ft in dia.









No wonder HYTRON® HOSE outperforms wire braid hose . . .

Hytron polyamide-polyester hose takes abuses that make other plastic and wire braid hoses fail. It's tough, durable, lightweight. Has 7 times longer flex impulse life than wire braid. It's versatile. Greater compatibility with mineral or synthetic fluids having a water or phosphate ester base gives Hytron a wider range of uses than other hoses. Available in long lengths, too—to 1000 ft. Some of the hundreds of applications especially suited to Hytron hose include:

Hydraulic lines	Non-conductive (electrical) applications
Hot paint lines	High-lines for electric power
Solvent lines	Fuel and oil lines

High pressure pneumatic and CO_2 lines

***Based on comparative tests with one-wire braid hoses.**

Find out how Hytron Hose can do the job better and save you money. Send for detailed report and test results—Bulletin NEPR-500.

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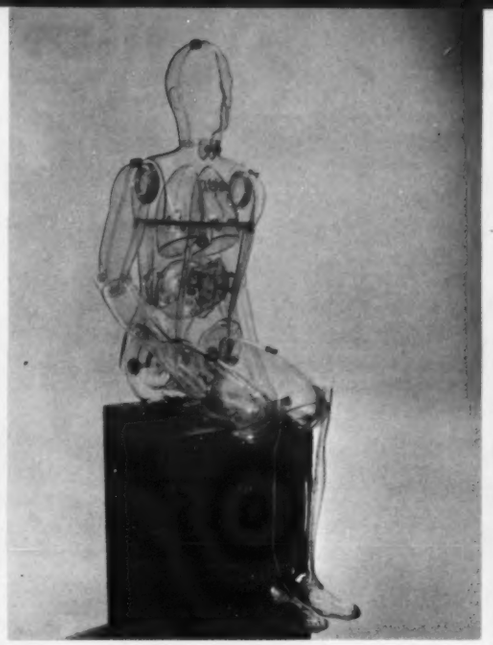
2. Tough polyester reinforcement—no wires to fatigue
3. Clean, nonporous, seamless polyamide inner tube

it's thermoplastic!

- Highly flexible—minimum bend radius is only half that of one-wire braid hose.
- 60% lighter in weight than wire braid hose.
- Smaller O. D. than same size I. D. wire braid hose—reduces assembly bulk, permits use of more couplings in confined areas.
- More resistant to more chemicals at higher temperatures than standard hose. Resists sunlight, mildew, aging.
- Temperature ranges from −40° to 225° F.
- Low diametrical expansion.
- Over 200 times the torsional fatigue life of wire braid.
- Available in long lengths—up to 1000 ft. Sizes ⅛" to ½".

Hytron hose furnished as factory-made assemblies with permanently attached couplings, or with easy-to-install, re-usable couplings in a wide range of sizes and styles.

IMPERIAL — EASTMAN



• **SYNTHETIC MEN** whose skin and organs are made of transparent plastic are helping science to gage the impact of radiation on the human body and to perfect techniques for controlling its use in biological applications. Vacuum-formed from optically clear butyrate sheet, the body shell and other parts permit unobstructed penetration of X-rays, gamma rays and neutrons, and possess stability under prolonged radiation.

One of two plastic figures created and fabricated for such experimentation is the REMCAL man, a synthesis of the term Radiation-Equivalent Manikin, Calibration. Made in 12 segments, the arms and legs of which are jointed, REMCAL has the size and contours of an average man. It contains counterparts of a thyroid, liver, lungs, spleen, kidneys and other organs, which are filled with a solution that simulates the reaction of soft human tissue when exposed to radiation.

Injection of radioactive solutions into REMCAL's organs enables technicians to calibrate whole-body counters and other specialized instruments and to obtain measurement data on body radiation following the application of given dosages.

The other plastic figure, in addition to its soft and hard tissue components, contains under its plastic shell a complete human skeleton. Ducts in the long bones of the arms and legs, in the vertebral column and in tubes that criss-cross other areas of the figure, accommodate dosimeters which measure the radiation absorbed by the respective bone and body parts.

The figures are manufactured by Alderson Research Laboratories, Inc., Long Island City, N. Y., from plastic sheets supplied by Nixon-Baldwin Chemicals, Inc., N. J., made from Tenite butyrate supplied by Eastman.

Circle 162 on Reader-Service Card

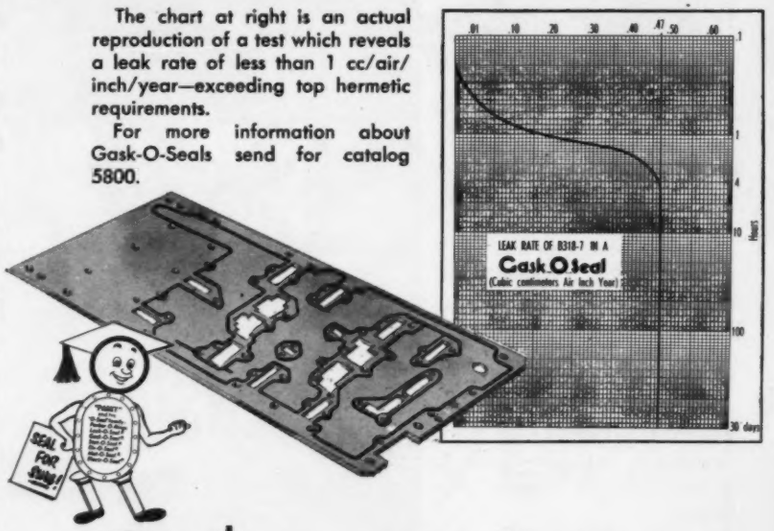
YOU CAN SEAL VACUUM and still get serviceability!

Gask-O-Seals meet, or exceed grade A MIL-8484 specifications for hermetic sealing, yet they are mechanical. That means you can seal a vacuum and still achieve full serviceability — easy access for repair, maintenance, re-setting, etc. You can seal components, "black-boxes," instruments, even complete systems — and re-seal them with the *same* seal!

The seal shown below illustrates the versatility of Gask-O-Seal — one piece seal actually doing the job of ten! Think of the freedom of design such a seal offers. Can they be put to use for your products, too?

The chart at right is an actual reproduction of a test which reveals a leak rate of less than 1 cc/air/inch/year—exceeding top hermetic requirements.

For more information about Gask-O-Seals send for catalog 5800.



Parker SEAL COMPANY

Culver City, California and Cleveland, Ohio

A DIVISION OF PARKER-HANNIFIN CORPORATION

Parker also makes seals for wave guide flanges that prevent R/F leakage and provide a positive no-leakage seal; a self sealing flush-head rivet called Riv-O-Seal, and many other specialized seals as well as o-rings and back-up rings. Your inquiry is invited.

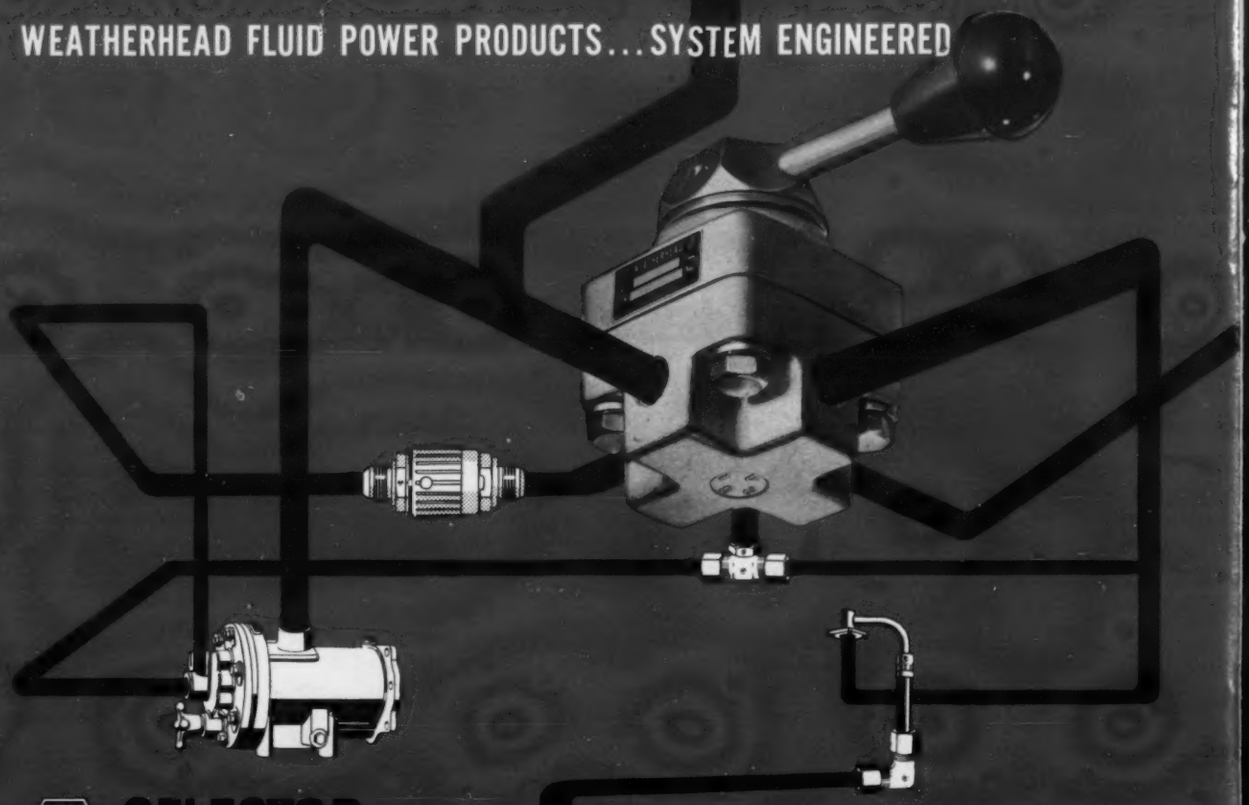
IDEAS IN THE NEWS

• **2.5 TON MACHINE**, so sensitive it can measure thrust as small as one-thousandth of a lb, will be used to measure precisely the thrust of ion rocket engines and other electrical propulsion systems. The machine was built by Rocketdyne, Div. of North American Aviation, Inc., and will be installed in a vacuum test chamber of the electrical propulsion test facility of the Aeronautical Systems Div., Air Force Systems Command, Wright-Patterson Air Force Base, Dayton, Ohio.

The machine accurately can measure thrust up to 10 lb and any specified micromatic range in between. It is capable of supporting an engine as large as a 3-ft cube, weighing as much as 200 lb, and operating at a power level of up to 250 kw.

The system uses a pendulum suspension to support the electrical propulsion device. Movement caused by the ion engine's thrust activates an electromechanical system, which balances the thrust force with an opposite force generated by a magnetic force motor. Thus, in operation, the suspension remains stationary and the amount of current required to keep the suspension in balance serves to measure the amount of thrust.

WEATHERHEAD FLUID POWER PRODUCTS...SYSTEM ENGINEERED



SELECTOR CONTROL VALVES STANDARDIZED FOR ECONOMY... ENGINEERED FOR VERSATILITY

Unmatched economy is achieved by standardizing on a 4-way design, adaptable to 2 or 3-way selection. Greater versatility is provided because this advanced control monitors hydraulic or pneumatic flow pressures ranging from zero to 3000 psi.

These outstanding capabilities eliminate need for additional spare parts on intermediate pressure models . . . assure availability from distributor stock . . . simplify varied application needs over wide pressure range.

Weatherhead selector control valves offer: safe, smooth operation ■ positive sealing ■ spring centered, or detent position handles ■ horizontal or vertical ports ■ panel mounting or flexibility within the system.

Contact your nearby Weatherhead distributor or write direct for latest brochure.

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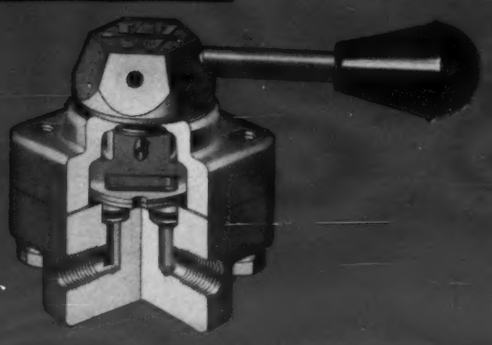
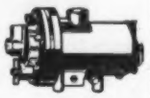
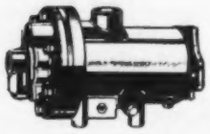


WEATHERHEAD
HYDRAULIC POWER
Components

VARIABLE DISPLACEMENT PUMPS

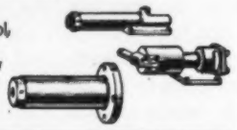




Meet J.I.C., S.A.E., and M.S. standards. Pressures to 3000 psi

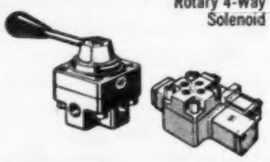
PUMP CONTROLS

Pressure Control, Automatic (Constant) Flow Control, Manual Displacement Control



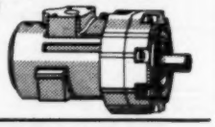
DIRECTIONAL CONTROLS

Rotary 4-Way Valves
Solenoid Valves



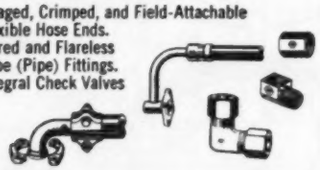
HYDRAULIC DRIVES

Fixed Displacement Hydraulic Motors, Reversible Variable Displacement Hydraulic Motors (Integrated Torque and Speed Control)



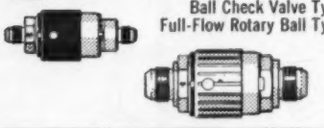
HIGH PRESSURE HOSE AND FITTINGS

Swaged, Crimped, and Field-Attachable Flexible Hose Ends. Flared and Flareless Tube (Pipe) Fittings. Integral Check Valves



SELF-SEALING COUPLINGS

Ball Check Valve Type
Full-Flow Rotary Ball Type



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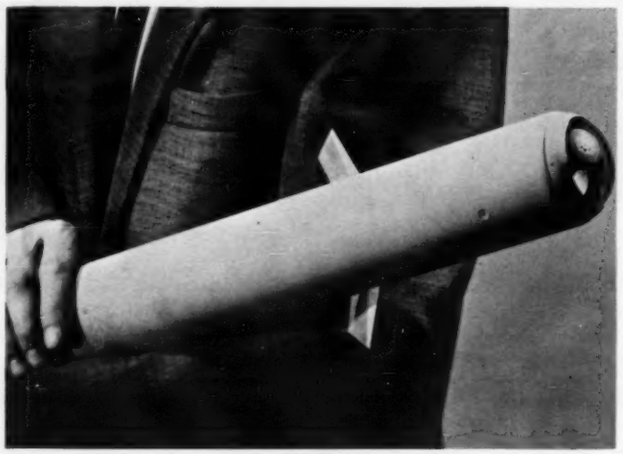
Circle 163 for Reader Service

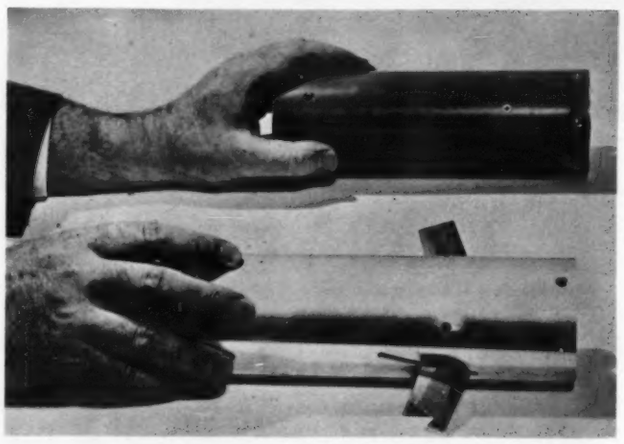
• **COMPLETE GUIDANCE SYSTEM** is placed within the small structure of the Redeye missile, now being developed by General Dynamics/Pomona. The Redeye is a surface-to-air weapon designed for use by foot troops against low-flying jets or conventional war planes. The entire missile weighs less than 20 lb and is approximately 4 ft long and 3 inches in dia.

The missile carries only a single pair of steering fins, placed near the nose and centered at a 15-deg angle. These snap in and out as the missile revolves around its axis, steering the Redeye in whatever direction is required to keep it on target.

The guidance system starts with a heat-seeking, infrared "eye" in the nose, which detects the heat exhaust from an aircraft and signals the missile onto a collision course. Electronic circuits determine the exact instant when the fins should snap out into the air stream. Since the missile is revolving many times a second, a corrective turn in any direction is always possible. The amount of turn is determined by how long the fins are extended.



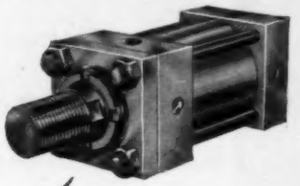
HEAT-SEEKING INFRARED GUIDANCE "EYE" in nose of Redeye antiaircraft missile. Pair of pop-out fins steer missile to intercept its target.



FORWARD SECTIONS of weapon illustrating pop-out action of guidance fins. During flight, fins alternately fold out of canted slots into airstream and snap back entirely within airframe.

A-O-K

AIR and HYDRAULIC CYLINDERS and BOOSTERS



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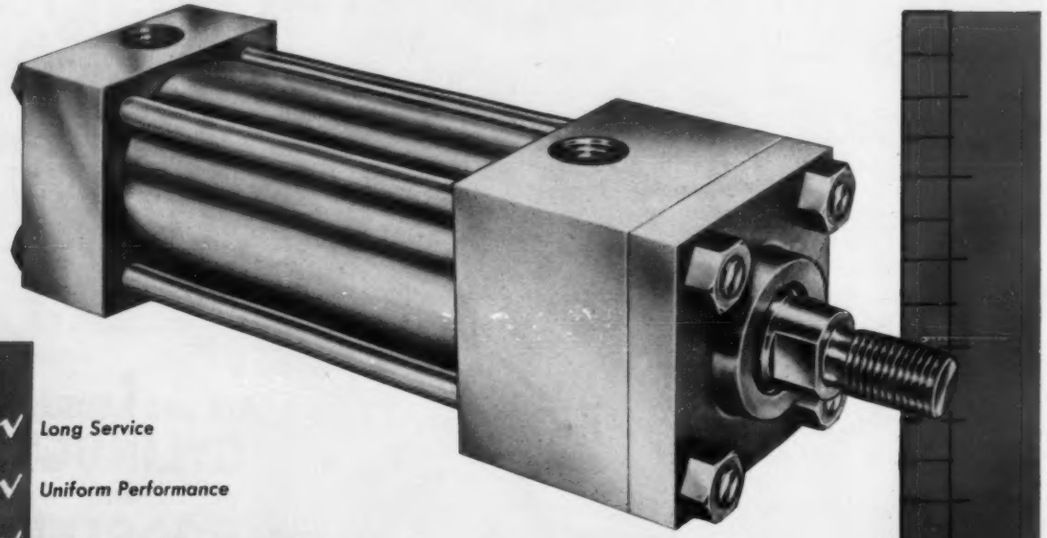
NEW O-M SQUARE-HEAD AIR AND HYDRAULIC CYLINDERS GIVE THE PERFORMANCE YOU EXPECT . . . AND MORE



- ✓ *Long Service*
- ✓ *Uniform Performance*
- ✓ *Dimensional Interchangeability*
- ✓ *High Operational Efficiency*
- ✓ *Compact — Saves Space*
- ✓ *Quick, Easy Maintenance*

Air—(rated 200 psi)
Hydraulic—(rated up to 2000 psi)
Meet JIC Standards 1½" to 14" Bores

Made of the highest quality materials and seals, these new components combine modern design, the latest and best engineering advancements with O-M specialized "know how" and precision workmanship.

New Series "K" Air Cylinders

Construction features include brass cylinder barrel, chrome-plated, high tensile steel piston rod with a minimum yield strength of 90,000 to 100,000 psi. Rolled and machined steel heads and extra long cartridge-type rod bearing assure perfect alignment of piston rod.

New Series "L" Hydraulic Cylinders

Similar in many construction features to Series "K", but specifically designed for hydraulic service. Incorporate vee-type rod packing and a cylinder barrel of micro-honed steel tubing which are best suited for hydraulic operations.

With the addition of the new Series "K" and "L" to the Ortman-Miller major line of air and hydraulic cylinders, you can now rely on O-M for *all* of your low and medium pressure cylinder requirements. Both Series "K" and "L" are dimensionally interchangeable with other cylinders of a like type. Fabricated, precision steel mounts and accessories assure precise mounting.

Mail coupon today for complete details. All cylinders in Bulletins 115A and 116 have been dimensioned in accordance with NFPA recommendations for your convenience.

ORTMAN-MILLER MACHINE COMPANY
3 143rd Street, Hammond, Indiana

☐ Have representative call
Please send Bulletin(s)
☐ 115A—Series "K" ☐ 116—Series "L"

NAME_____
POSITION_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE____ STATE_____

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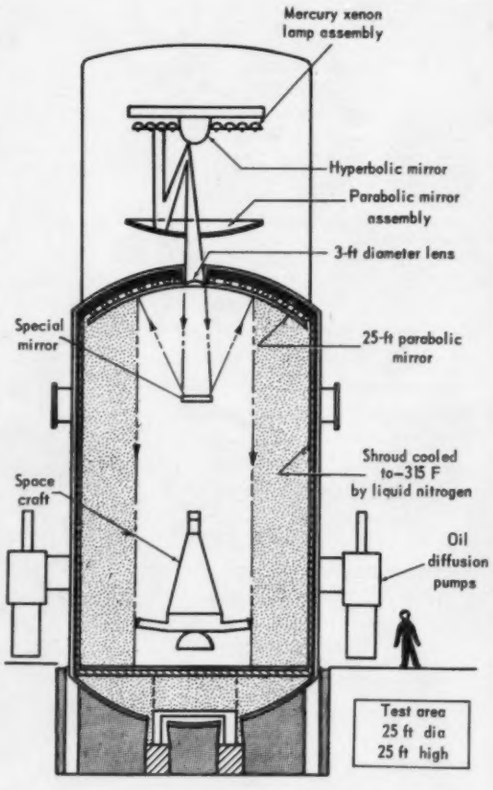
IDEAS IN THE NEWS

• **FOUR-MILLION-DOLLAR CONTRACT,** awarded by the California Institute of Technology Jet Propulsion Laboratory to Consolidated Vacuum Corp., a Bell and Howell Co./CEC subsidiary, calls for the design and construction of a space environmental facility that will create on earth an atmosphere known to exist in outer space.

The simulator will be a cylindrical, stainless steel tower, 80 ft 4 inches high and 27 ft in dia. Lower part of the chamber will be a stainless steel vacuum area that measures 47 ft high by 25 ft in dia. Space vehicles to be tested will be placed in this area. The upper housing of the chamber will contain a solar simulation unit, capable of reproducing the sun's rays and concentrating them on the surface of the space vehicle. It is claimed that there is not another chamber of this size presently in existence that will actually simulate space and also is able to create the sun's energy artificially.

A three-stage pumping system will be utilized to accomplish the task of creating an atmosphere similar to that of outer space. The first stage will be accomplished by using seven compressors that are ordinarily used to run supersonic wind tunnels. After these compressors have completed their job,



the line will be valved off and a roughing system, consisting of vacuum blowers and Roots vacuum pumps, will remove another portion of the atmosphere. Finally, an oil diffusion pump will take over to finish the evacuation of the chamber. When evacuated, the chamber will simulate conditions found at approximately 250 miles above the earth's surface.

Ten large pumps surround the lower half of the large tank. These pumps are designed to run continuously for great periods of time in order to overcome the problem of heat reflection and maintain the state of vacuum inside the chamber.

The optical system, designed by Bausch and Lomb, will consist of 150 compact arc mercury xenon lamps; each lamp using 2-1/2 kw of power. Light from the mercury lamps will shine down on a parabolic mirror and will be reflected upward in a concentrated beam to a hyperbolic mirror. Once again, the beam of light will be reflected downward through a lens into the vacuum chamber. While under vacuum conditions, the beam of light will be widened through further reflection from a parabolic mirror inside the vacuum area and will shine on the spacecraft in a collimated beam. Intensity of the artificial sunlight will be varied through a control system, allowing the study of effects of solar rays on a space vehicle as close to the sun as Venus and as far away as Mars.

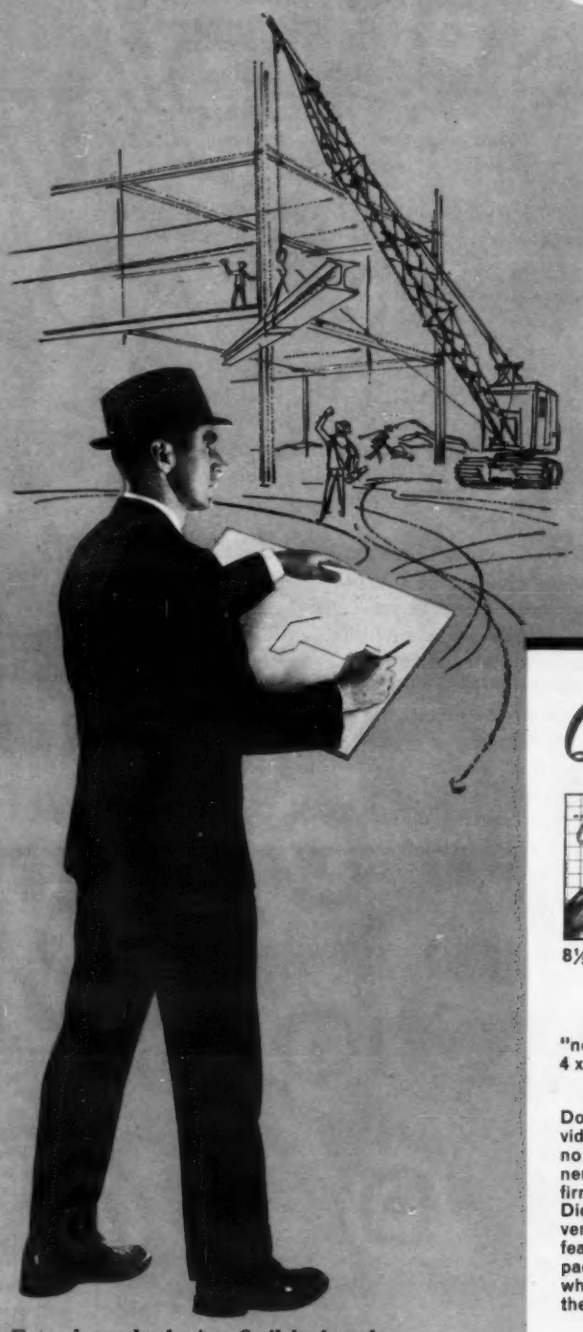
In order to maintain actual space conditions in the chamber, an aluminum shroud was designed. The shroud will have 200 plates which are dull black and can absorb great quantities of heat and can be cooled to temperatures of —320F. This will be accomplished by running minute tubes of liquid nitrogen through the shroud. As a result of this feature, 99 percent of the heat radiated from the spacecraft will be absorbed and carried away.

Circle 168 on Reader-Service Card

for fast, accurate on-the-job sketches,

DIETZGEN

DRAW IT WITH Quikdraft



Extra-heavy back gives Quikdraft pads extra support . . . it's like having a portable drafting board on the job.

Now you can create dimensionally accurate "freehand" sketches anywhere, anytime with Quikdraft . . . the new professional drafting pad. Quikdraft features Dietzgen's famous drafting vellum printed with an accurately centered "no-print" grid. The grid appears as light blue lines and serves as a convenient scale guide in creating all types of architectural and engineering drawings. But because the grid will not reproduce, prints from your Quikdraft sketch show only the pencil drawn lines and lettering. Now with the aid of a straight edge, your freehand sketches become finished detail drawings saving hours of tedious boardtime re-drawing rough sketches.

Available in three standard sizes and your choice of 4x4, 8x8 and 10x10 squares to the inch grids, Quikdraft pads are stocked by your nearby Dietzgen Dealer. He is listed in the yellow pages under "Drafting Equipment & Supplies" . . . see him today. EUGENE DIETZGEN CO., Chicago 14, Illinois.

Quikdraft pads

8½ x 11

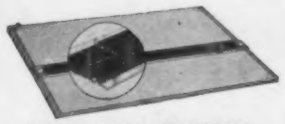
11 x 17

17 x 22

"no-print" grid scale guides...
4 x 4 8 x 8 10 x 10

Double flap construction provides 4-corner protection . . . no soiled or dog-eared corners. Under-flap provides a firm, smooth drawing surface. Dietzgen Redi-reference conversion tables are a bonus feature with every Quikdraft pad. Saves time, saves errors when making calculations on the job.

MAYLINE

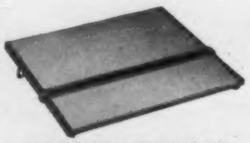


PARALLEL RULING STRAIGHTEDGE

Choose Your Christmas Gifts Now!

The Mayline products shown are ideal Christmas gifts. These and other products are ready for prompt shipment, directly to you.

See your local dealer today and reserve the product you want. Early orders insure delivery for Christmas.



PROFESSIONAL DRAWING KIT

MASTER TABLE

MAYLINE CO., INC.
529 No. Commerce St.
Sheboygan, Wisconsin

MAYLINE MAYLINE MAYLINE

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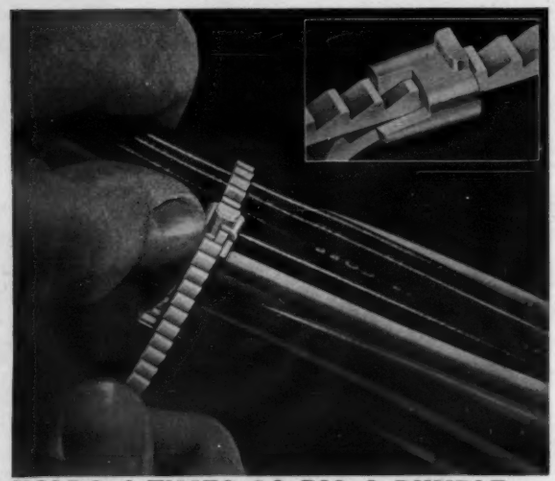

HOLDS 4 TIMES AS BIG A BUNDLE— HOLDS AT 50 G'S

Genuine Bund-L-Tite* nylon straps are twice as long and fully 10 times as strong as any other bundle-tying strap made. This means that you can secure larger bundles at greater stresses. Bund-L-Tite is fast and simple, too: just pull the self-locking strap around the wires. No tying, no knots, no hitches to come loose. Light-weight DuPont zytel meets MIL-P-17091. ⅛" size holds 40 lbs. tension; 3/16", 175 lbs.; ¼", 325 lbs. IMITATED BUT NOT DUPLICATED. Write for free literature.

DAKOTA ENGINEERING, INC.
4315 Sepulveda Blvd., Culver City, California

Manufacturer of Cab-L-Tite clamps.
*Trade Mark

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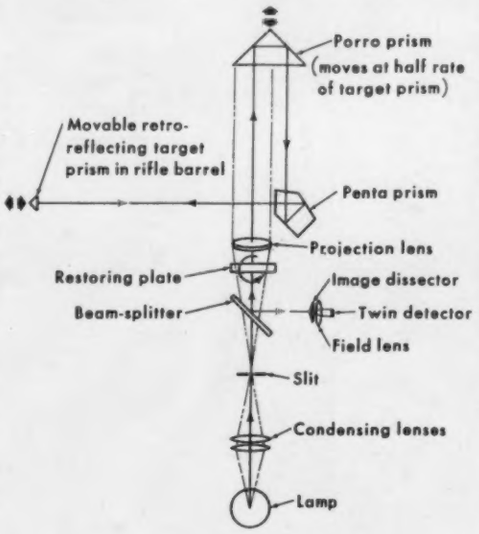
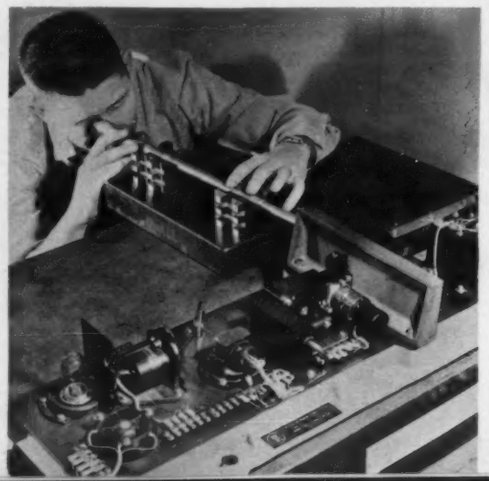
IDEAS IN THE NEWS



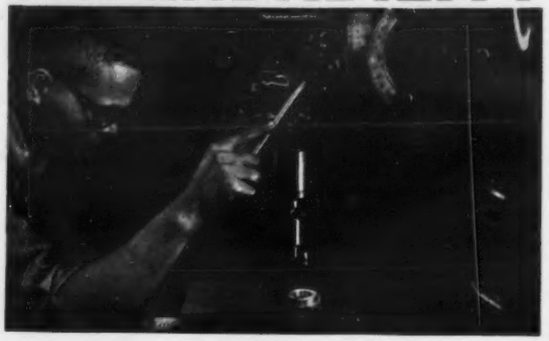
• **OPTICAL SYSTEM** checks straightness of a 30-caliber rifle barrel to within 0.003 inch. When completed, the checker will plot deviations on a recorder and directly correlate them with their location so that barrels may be straightened scientifically.

The optical servosystem consists of a light source and an arrangement of lenses, a beam splitter and a variety of prisms, designed to reflect the test beam from a probe pulled through the rifle barrel. Ultimately, this beam impinges on a lead-sulfide detector, which, by the change in signal strength received, causes rotation of a servo-driven restoring plate. The amount of rotation is the final output which is converted directly into a numerical error signal.

The optical device offers greater checking speed and higher accuracy. It is expected that 60 rifle barrels per hr may be tested. The system, designed and built by Barnes Engineering Co., Stamford, Conn., was built under contract to Associated Engineers, Inc., for use by the Springfield Armory.



DEPENDABILITY



THESE HANDS ATTUNED TO QUALITY. The best raw materials . . . machined with modern tools, in the end, rely on the skilled hands of the machinist to turn out reliable hydraulic cylinders. CROSS craftsmen's skill has been forged by years of experience, tempered by the discipline of rigid, station-by-station inspection.

CROSS MANUFACTURING COMPANY
Lewis, Kansas / Phone EA 4-5525

CROSS Engineers Available to You for Free Consultation!

C 5-161

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BRADY WIRE MARKERS STICK

. . . TO YOUR FINGER from Card to wire. No troublesome tabs to remove . . . no chance to drop or lose Brady Markers.

. . . TO THE WIRE—any size wire up to ⅞" diameter—permanently . . . stay stuck in temperatures to 300°F. 1½" or ¾" Markers available from distributor stocks in 200 major cities.

4 MARKER SIZES — 6 MATERIALS
3000 STOCK ITEMS
350 Distributors for Fast, Local Service

FREE NEW Bulletin and Testing Samples. Write:

107

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Manufacturers of Quality Pressure-Sensitive Industrial Tape Products, Self-Bonding Nameplates, Automatic Machines for Dispensing Labels, Nameplates, Masks and Tape
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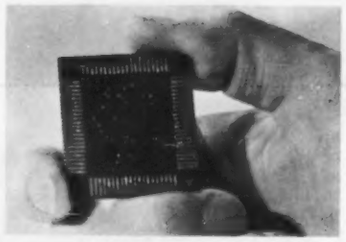


ARITHMETIC UNIT, made up of interwoven magnetic ferrites, is part of logic circuit of magnetic digital computer.

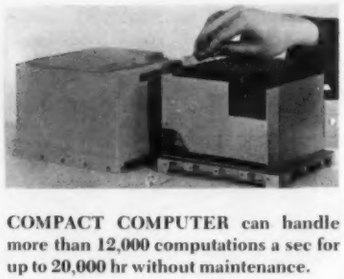
MAGNETIC DIGITAL COMPUTER, claimed to operate reliably up to 40 times longer than comparable equipment, is used as the brain of a space vehicle guidance and control system.

The computer's reliability is achieved by replacing transistors and diodes with magnetic ferrites that have a life expectancy up to 1000 times longer. In some circuits, one ferrite replaces as many as 24 semiconductor elements.

The magnetic materials have resistance to the effects of nuclear radiation. Tests have shown that the various magnetic components used are as much as 100,000 times more resistant to radiation damage than transistors and diodes.

The device includes a solid-state magnetic memory. It performs between −67 to 250F without special compensations. Providing permanent storage of computer instructions, the memory is made up of elements that can be packaged at densities up to 2700 per cu in.

Weighing only 19 lb and occupying less than 1/2 cu ft, the computer requires less than 90w to operate. It was developed by Sperry Gyroscope Co., Great Neck, N. Y.



COMPACT COMPUTER can handle more than 12,000 computations a sec for up to 20,000 hr without maintenance.

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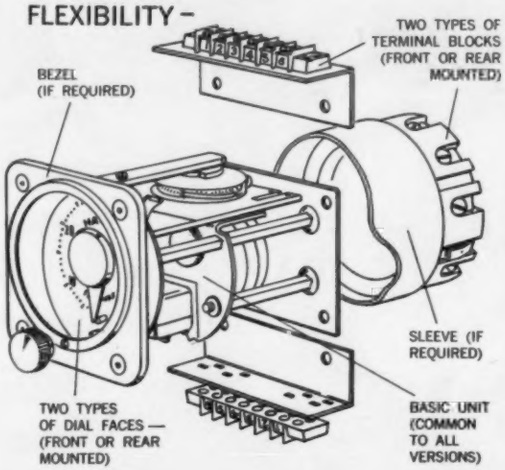
NEW External Clutch Reset ACROTIMER

FLEXIBILITY –


TWO TYPES OF TERMINAL BLOCKS (FRONT OR REAR MOUNTED)
BEZEL (IF REQUIRED)
SLEEVE (IF REQUIRED)
TWO TYPES OF DIAL FACES — (FRONT OR REAR MOUNTED)
BASIC UNIT (COMMON TO ALL VERSIONS)

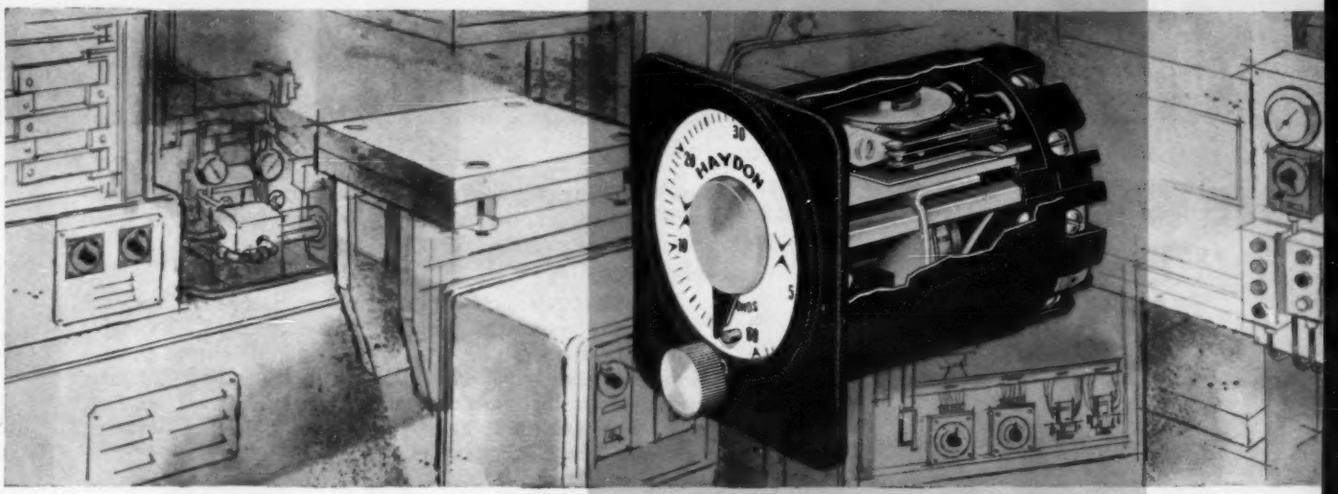
Provides time delay or interval timing, opening or closing one or more switches after an adjustable period of time — and, in addition, offers you these advantages.

EXCEPTIONAL VERSATILITY . . . results from modular construction concept. One basic unit plus easily assembled standard parts provides 12 different variations to meet a very wide range of physical and electrical requirements. Reduces cost, speeds deliveries.

LOWER COST . . . than other units of comparable capacity and quality, because of savings made possible by advanced design and modular construction.

SIMPLE CONSTRUCTION . . . with fewer moving parts. This means greater dependability and contributes to lower purchase price without sacrificing quality and performance.

COMPACT . . . ½" shorter than the next smallest competitive unit and 1" smaller than most competitive units.



Supplied for rear or panel mounting, the ACROTIMER line is designed for operation at 120 to 240 vac, 50 or 60 cycles. Adjustable time ranges from 6 seconds to 4 hours are available. For complete information on these timers, write today for your free copy of the new Haydon ACROTIMER Catalog.

HIGHER RATED LOAD SWITCHES . . . with your choice of one 15-amp or two 10-amp switches.

SPRING-TYPE CLUTCH . . . means negligible wear; longer life; and faster, more positive engagement.

TIMING MOTORS
TIME AND TORQUE CONTROLS

HAYDON

DIVISION OF GENERAL TIME CORPORATION

3234 EAST ELM STREET
TORRINGTON, CONNECTICUT

Smooth output at lowest shaft speeds...

NEW WEBSTER HYDRAULIC MOTOR WITH INTEGRAL GEAR REDUCER

This new Webster gear-type fluid motor combined with a planetary gear reducer was designed for high torque, low speed operations. High reduction ratio (4.65:1) assures smooth output at lowest shaft speeds!

The unit is extremely compact and provides stable, constant speed operation under varying loads. When used with a variable output flow divider, it becomes the high torque output element of an infinitely variable transmission. It is ideal for indexing, turning and transfer mechanisms; hydrostatic drives, winches, reels; turning or tilting units; batch mixers; driving elevators, conveyors — even earth augers.

The Webster motor-gear reducer has other important advantages: it may be used where it is impossible to use an electric motor because of explosion hazards... planetary gear assembly is lubricated by the hydraulic system... "straight through" drive between input and output shaft... mounts on an SAE standard, 4-bolt D size hydraulic pump mount. Drive is direct, gear or belt.

Your Webster Electric representative can tell you more about this interesting new hydraulic motor with integral gear reducer — or write direct for engineering detail sheet HY6-1.

SPECIFICATIONS:

Models: 5, with a torque range from 39 to 142 inch pounds per 100 psi.
Input flow: Gpm at 1000 psi —
2.2 to 5.8 at 100 rpm output speed
4.9 to 15.5 at 300 rpm output speed
7.5 to 25.1 at 500 rpm output speed
Gear reduction: 4.65 to 1
Operating pressure: up to 2000 psi standard
Pumping gears: smooth-running spur involute — precision hobbed from alloy steel
Motor drive: free-floating internal spline
Seal: mechanical face-type on drive shaft
Porting: 1" NPT inlet and outlet standard, 1¼" "O" ring straight thread optional. ¼" NPT drain port.
Mounting: SAE-type "D" four-bolt mounting standard
Drive: Direct, gear or belt
Weight: 48 to 51 lbs.

OIL HYDRAULICS DIVISION
WEBSTER ELECTRIC
RACINE · WIS

franklin adv. H129A

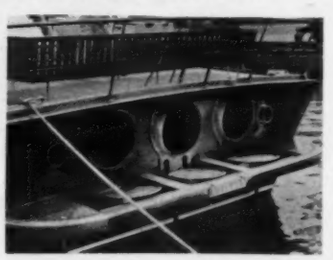
IDEAS IN THE NEWS

M. Y. MERCURY is believed to be fastest private yacht in existence. Three gas-turbine engines propel the vessel at speeds in excess of 50 knots.

• **EXPRESS YACHT,** designed and built by Vosper, Ltd., England, is based on the "Brave"-class fast patrol boats built by the same company for the British Royal Navy. The yacht is powered by three Bristol Siddeley Marine Proteus gas turbines and has a speed in excess of 50 knots. Built for Stavros Niarchos, the Greek shipping magnate, she is believed to be the fastest private yacht in the world.

The Marine Proteus embodies a free-power turbine and is so flexible that it can be used satisfactorily for all slow-speed maneuvering. The yacht does not have any auxiliary propulsion machinery. The use of a free-power turbine also enables the engine to deliver extremely high power at low or medium propeller speeds, which gives the vessel rapid acceleration.

No warming-up period is required so that full power is instantly available at all times. Overhaul life of the Marine Proteus is about 2000 hours.



EXHAUST PORTS of gas-turbine engines.

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Wheel Brake and Swivel Lock Casters
Completely Sealed Casters
Wheels of all sizes and types
Extra Heavy-Duty Casters
Dual or Triple Wheel Casters
Medium Duty Casters
V-Groove Wheel Casters

your BEST move!

ALBION *industrial . . .* CASTERS

Albion casters checkmate your materials handling problems. They are versatile, dependable, economical and available *right now.* Whether you need a caster for light, medium, heavy or extra heavy duty requirements—standard or special—Albion casters are the practical answer.

Albion casters are available in every conceivable range of industrial size, type, capacity and desired wheel type to suit your needs.

Make the *best* move . . . get all the facts on Albion Casters today. Write, wire or phone for the information you need. Albion is always at your service.

Do it now . . .

request your copy of the Albion Caster and Wheel catalog. Yours for the asking.

ALBION INDUSTRIES, INC.

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MAIN PLANT:

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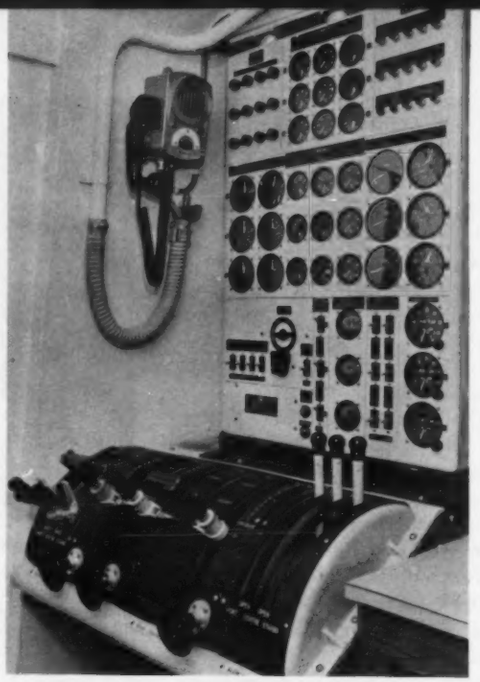


CONTROL PANEL and instrumentation.

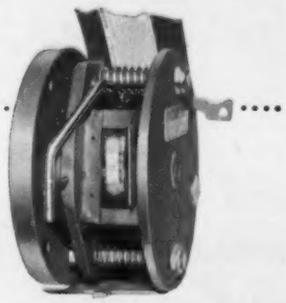
• **TRANSISTORIZED, LIGHT-SENSITIVE TV SYSTEM** will televise night fighter-interceptor tactics at the World Wide Weapon's Meet at Tyndall AFB, Panama City, Fla. Military observers, judges and visitors to the Meet will "ride" with the "chaser" pilots at night and observe, via television, the pursuit and kill of jet interceptor teams.

The new camera will televise action at light levels even below that of the stars and jet exhausts of the planes and drones. It weighs about 12 lb, has power needs less than 100w and will provide usable pictures at light levels down to 0.01 foot-candle.

The system uses an "Image Orthicon" camera tube and will deliver 600-line resolution. It includes the camera, a lightweight camera control unit and a video monitor. The system was developed by Thompson Ramo Wooldridge, Inc., Dage Div., Michigan City, Ind.

db LET DINGS DO IT!

NEW **COMPACT** BRAKE



WRAP AROUND COVER

No extra space needed for cover removal. Ideal for confined spaces.

No special motor design. Fits all motors without disassembly.

The new Dings "Universal" Series 60 — 1½ and 3 lb. ft. torque Compact Brake offers all the advantages of Dings standard brakes *plus* the economy and convenience of easy, fast attachment and easy access. Here's assurance of an attractively compact, brake-motor package!

For NEMA motor frames 56C, 66C, 182C & 184C (all manufacturers). For continuous or intermittent service.

1. Slide brake on the motor shaft.
2. Bolt to standard NEMA "C" flange mounting.
3. Knockout plug provided for Thru-Shaft feature on all units.

Write for further details.
Ask for BULLETIN BK4709.

DINGS BRAKES, INC.

A SUBSIDIARY OF DINGS MAGNETIC SEPARATOR CO.

4710 West Electric Avenue
Milwaukee 49, Wisconsin

DB-361

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Just Out! Just the ticket to cut cost!

⅛" —$3.00
¼" —$3.25

ROSS "CUB"

CUB

NEW SPEED CONTROL VALVE

⅛" and ¼" pipe sizes in stock now!

Now a speed control valve that regulates your cylinder movement with precision and sureness, but which lists at $3.00 and $3.25. And despite its lower costs, "CUB" features the same high quality of design and workmanship you've come to expect from Ross. "CUB'S" design stresses trouble-free operation and easy maintenance. CUB is small, aluminum and lightweight. If you use speed controls, by all means call your Ross representative or write us.

ROSS OPERATING VALVE CO.

106 E. Golden Gate Ave. • Detroit 3, Michigan

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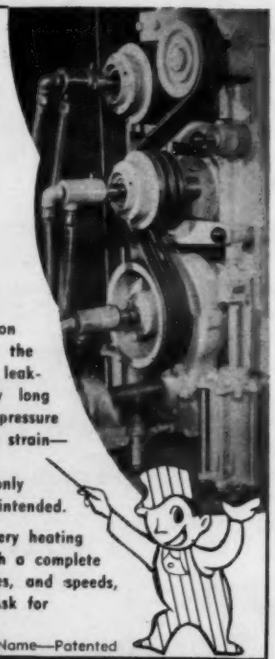
the ROTARY UNION* the revolving joint with built-in protection



The automatic built-in features on this rotating joint explain why the Rotary Union gives completely leak-proof service for exceptionally long periods. It is self-adjusting to pressure fluctuations and self-aligning to strain—thus allowing its precision mechanical seal to accomplish only the sealing job for which it was intended.

There is a Rotary Union for every heating and cooling application—through a complete range of pressures, temperatures, and speeds, in pipe sizes ¼" through 5". Ask for Bulletin 700.

*Trade Name—Patented

"WHERE Good Connections COUNT"

PERFECTING SERVICE COMPANY, 332 Atando Ave., Charlotte, N.C.

Baltimore—Buffalo—Camden, N. J.—Chicago—Cleveland—Los Angeles
New York—Providence—Montreal—Toronto

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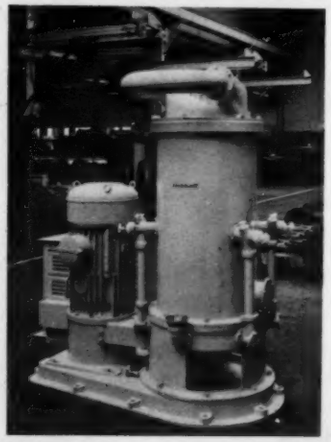
IDEAS IN THE NEWS

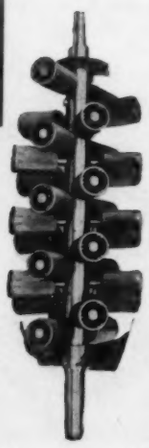
• **"CHRISTMAS TREE"** rotor is the moving element of a novel pulverizer, in which fluidized particles are ground down to micron range. Grinding is accomplished without direct metal contact; as particles pass through a vortex field, alternating stresses cause structural disintegration. Advantages are extreme size reduction coupled with low wear of mechanical parts.

The hollow vertical rotor shaft carries in a helical arrangement a set of radial cylinders. Surface of cylinders is honeycombed with polyhedral passages. A similar surface treatment is given to the stator inside the jacket, which can be heated.

The rotor assembly spins at 4000 rpm, sucks in carrier gas and solid particles from the bottom. A total of about 130,000 passages with air-cutting edges generates a field of very small vortices superimposed on the helical bottom-to-top motion of the gas. Extremely rapid stress changes between adjacent microvortices accomplish the grinding. Total transit time through the Christmas tree is less than 1 sec.

The "Micromolitor" processes 45-110 lb/hr absorbs 24 kw and is manufactured by Gebr. Eickhoff Maschinenfabrik und Eisengiesserei Bochum, Germany. R.F.S



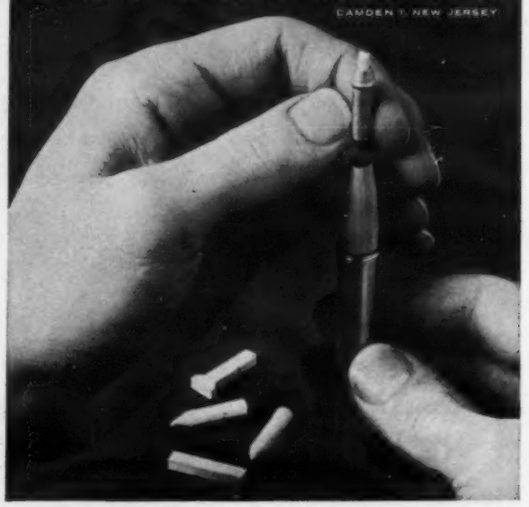


King-Size Flo-master marks on everything

It's the world's only king-size *refillable* felt-tip marking pen. Designed especially for shipping room table and factory bench. Extra-large ink capacity. Takes replaceable felt tips up to 1" wide. Choose among 8 transparent ink colors. Try it. Only $4.00.

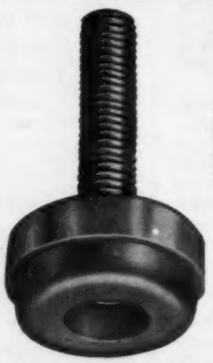
ESTERBROOK

CAMDEN 1, NEW JERSEY



Circle 179 on Reader-Service Card for more information

OHIO ADJUSTING SCREWS



FB ADJUSTABLE FEET WITH NON-MARKING GRAY PAD

A handsome, sturdy part that provides suction to hold equipment in place, absorb vibration, prevent marring of floors and improve product appearance.

Thread sizes 5/16-18 to ½-13

FT ADJUSTABLE SCREWS

Large hex head gives broad cupped base for easy hand adjustment. Used extensively on appliances as adjustable feet and as hand adjusting screws.

Thread sizes ¼-20 to ½-13

OHIO ADJUSTING SCREWS

OVER 50 YEARS OF BETTER FASTENING

Samples and information available upon request

THE OHIO NUT & BOLT CO.

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looking for better than
jewelry quality
in precious metal tubing?

If you are a nuclear or electronics engineer looking for a supply of jewelry quality small tubing in silver, gold, palladium or their alloys, here's good news! The quality tubing you seek is available from UNIFORM TUBES with O.D.'s from 0.005″ to ⅜″. What's more, you can order this tubing precision drawn to any wall thickness from 0.035″ down to 0.001″ within tolerances of ±0.0005″ . . . ±0.00025″ on the smallest sizes!

UNIFORM cuts this tubing to specified lengths with ends square and free of burrs. UNIFORM's experience in working precious metals is also available for the fabrication of tubular parts. Flaring, coining, bending and other fabricating steps are completed with the same precision and skill applied to drawing the precious metal tubing.

Where the corrosion resistance or special properties of a precious metal are needed on either O.D. or I.D. only, UNIFORM supplies COMPOSITE TUBING with the precious metal drawn over a precision tube of a less expensive base metal or vice versa.

Composite tubing meets the same close tolerances and quality standards UNIFORM sets for tubing of silver, gold, palladium or their alloys.

Phone, wire or write today for details and a quotation. Delivery is normally less than three weeks.

UT
UNIFORM TUBES, INC. COLLEGEVILLE 2, PA.
HUxley 9-7276 TWX-CGVL 1044

Circle 181 on Reader-Service Card

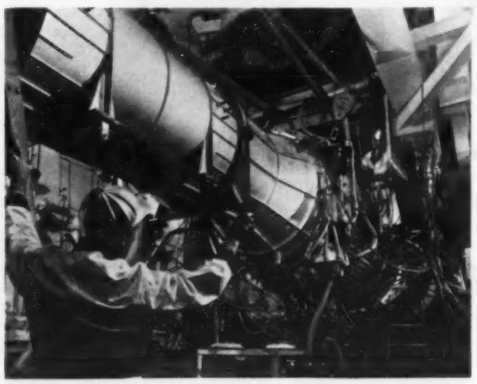
• **SOLAR CONCENTRATOR** for generating power for space stations will be built at the Arizona Div. of Goodyear Aircraft Corp. The U. S. Air Force will use the concentrator to power a 15-kw solar mechanical energy system which is being developed by the Sundstrand Turbo Div. of the Sundstrand Machine Tool Co., Denver, Colo.

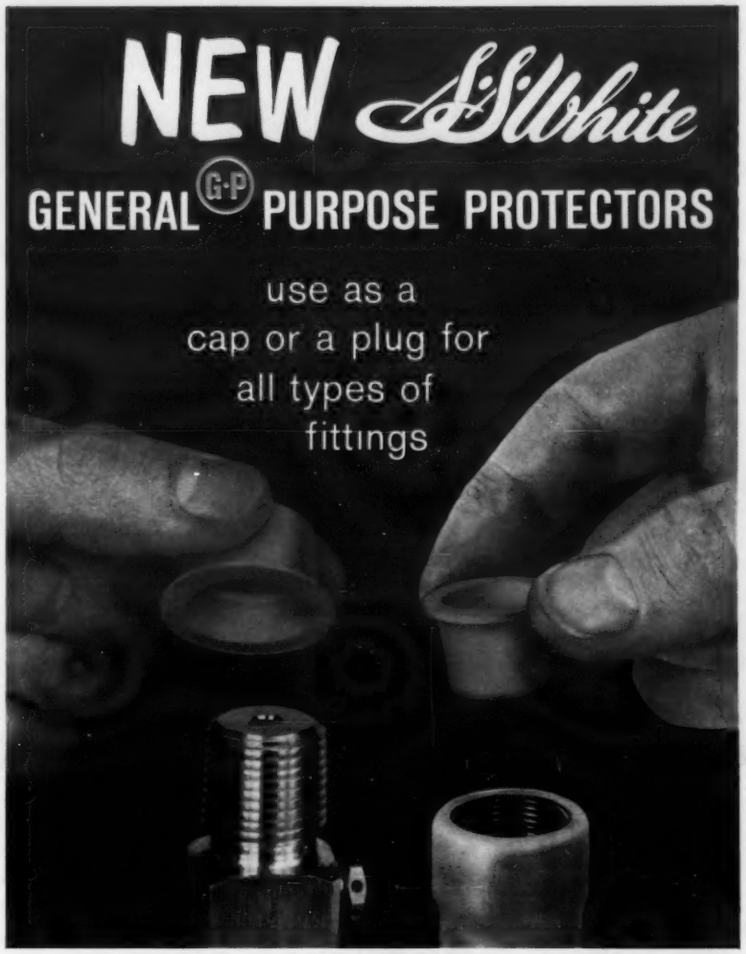
The concentrator will measure 44.5 ft in dia and will be made of flexible, lightweight, highly reflective materials. Once in orbit, the concentrator will be inflated into an extremely accurate parabolic shape, then will be made rigid with foam plastic for long-time space occupancy.

• **J-93 TURBOJET ENGINE**, six of which are scheduled to power the B-70 bomber, is in an advanced development stage at General Electric's Large Jet Engine Dept. Combined thrust of the engines will propel the bomber faster than a high-powered rifle bullet—about 2000 mph—at altitudes between 60,000 and 70,000 ft.

Like the J-79, the J-93 uses variable-incidence stators in the compressor to control high-velocity air flow. This design approach facilitates the use of a single-spool rotor and three main support bearings. As a result, engine weight is minimal and maintenance is simplified.

The J-93 also retains the J-79's converging-diverging exhaust nozzle principle, which operates in conjunction with the fuel control system to provide optimum fuel economy and high air flow and thrust at Mach 3 cruise conditions. Controls and accessories are concentrated in a removable pod mounted beneath the compressor section.





Eliminate special sizes...fit more accurately!

S. S. White General Purpose "GP" Plastic Protectors are an improved way to protect your products during manufacturing, shipping and storage.

Each GP protector can be used as either a cap or a plug on all machine screw threads, pipe threads, and tubing in a range from ¼″ to 2¼″... with an accurate, *engineered* fit. GP protectors eliminate special sizes and fit better!

"GP" protectors are made of a special grade of elastic polyethylene that cushions shock and is unaffected by oils, greases, acids and other common solvents. They have a "stay-put" fit, yet they are easy to grip for a quick, *non-shredding* removal.

Start now to *put an end* to customer complaints about damaged equipment. Use low cost GP protectors!

WRITE FOR BULLETIN 6104-GP
Complete details

1117

S. S. White PLASTICS DIVISION
Dept. 26P 10 East 40th Street, New York 16, N. Y.

Circle 182 on Reader-Service Card for more information

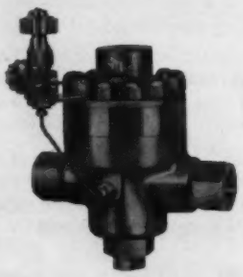
VICTOR "CLEAN" REGULATORS

Control gases safely and accurately to 10,000 psig.

Victor high pressure gas regulators are cleaned, assembled, tested and packaged under carefully controlled conditions to insure maximum product reliability. Cleaning is performed to Victor standard or to customer specifications in a room approved by industry and military agencies. Regulators shown here are typical of the available models covering a range of pressures to 10,000 psig. and capacities of 80,000 scfm. at —67° F. to +250° F. Write for Regulator Inquiry Form 361B and regulator bulletins.

GD700 SERIES
GAS-O-DOME REGULATORS

Bronze or stainless steel
Pilot operated—low torque
Inlet to 10,000 psig.
Outlet to 10,000 psig.
Flows to 250 scfm.
Panel Mounting



GD40, GD90, GD100, GD200 SERIES
GAS-O-DOME REGULATORS

Bronze or stainless steel
Remote or integral controlled
Inlet to 6,000 psig.
Outlet to 6,000 psig.
Flows to 80,000 scfm.
Panel mounting if desired.

LR SERIES LOADER REGULATORS
BPR SERIES BACK PRESSURE
REGULATORS

Bronze or stainless steel
Inlet to 10,000 psig.
Outlet to 10,000 psig.
Flows to 10 scfm.
Low operating torque:
40 inch lbs. at 7,000 psig.
60 inch lbs. at 10,000 psig.
Panel mounting.

GD60 AND GD80 SERIES
GAS-O-DOME REGULATORS

Bronze or stainless steel
Remote or integral controlled
Inlet to 10,000 psig.
Outlet to 10,000 psig.
Flows to 2,000 scfm.
Panel mounting if desired.

VICTOR ...tors

VICTOR EQUIPMENT COMPANY
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1145 E. 76th St., Chicago 19
J. C. Menzies & Co., Wholly-Owned Subsidiary

Mfrs. of high pressure and large volume gas regulators; welding & cutting equipment; hardfacing rods; blasting nozzles; cobalt & tungsten castings; straight-line and shape cutting machines; roller and idler rebuilding machines.

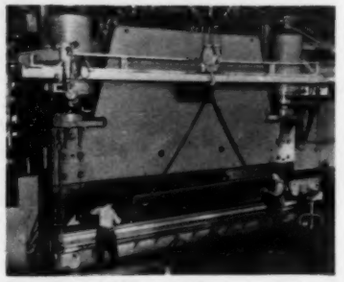
73

IDEAS IN THE NEWS

• **METAL-BENDING MACHINE,** claimed to be the most powerful of its type ever built, delivers 4,000,000 lb of pressure—enough to shape sections of super-strength alloy steel measuring 26 ft wide and 1-1/4 inches thick. The machine covers more than 350 sq ft of floor area, rests in a pit 11 ft below the floor and extends more than 21 ft into the air.

The press has a 24-inch stroke, a bed 26 ft long by 2-1/2 ft wide and operates at pressures up to 3000 psi. A 200-hp electric motor drives the hydraulic pumps.

The control system permits selection of four different pressing speeds in increments from 5 to 24 ipm, depending upon whether the press is being used for punching,



medium forming or heavy forming. There is a fast advance speed of 180 ipm and also a fast return speed of 135 ipm.

An automatic governing control in the hydraulic system constantly maintains the ram in a level position. If one cylinder lags, the system automatically bleeds oil from the lead cylinder and feeds the lagging cylinder. A method of tilting the ram also has been provided for use in forming conical shapes. A handwheel adjustment sets the required angle of tilt.

The press was designed and built by Vernon Allsteel Press Co., Chicago, and installed by Hans Lochen & Son of Milwaukee in the Milwaukee plant of Harnischfeger Corp.

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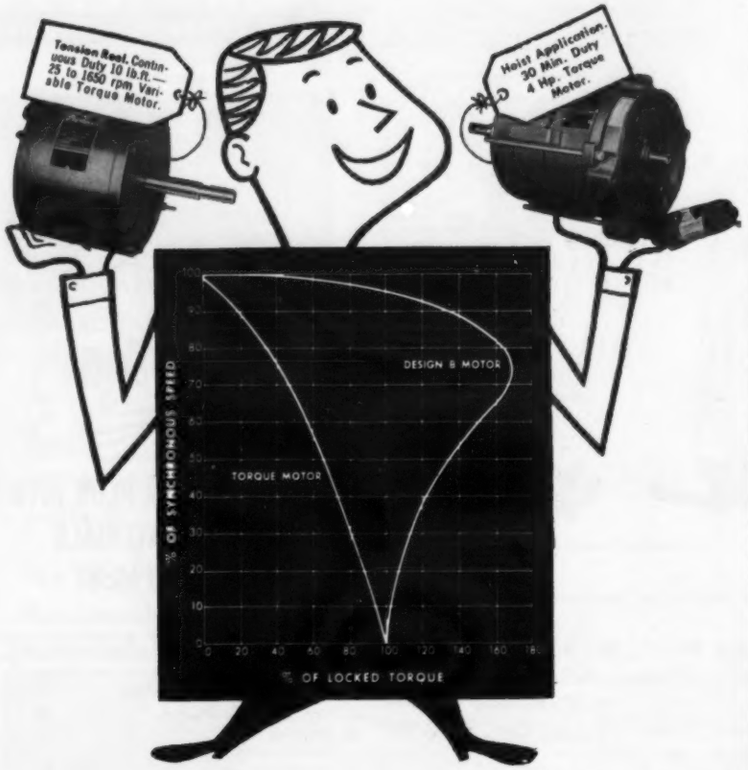

Tension Reel. Continuous Duty 10 lb.ft. — 25 to 1650 rpm Variable Torque Motor.
Hoist Application. 30 Min. Duty 4 Hp. Torque Motor.
DESIGN B MOTOR
TORQUE MOTOR
% OF SYNCHRONOUS SPEED
% OF LOCKED TORQUE

Comparative Speed-Torque Curves of NEMA Design B Motor and Typical Torque Motor. The speed torque curve varies from that of a conventional motor. The torque motor curve is almost linear. Maximum torque occurs at the stalled position. For this reason, torque motors are used most often where a holding or resisting force is required.

When holding or resisting force is needed . . . TORQUE MOTORS from PEERLESS ELECTRIC

Motors for tension reel, hoist or those with brake, more often than not call for a special design. That makes Peerless one of your best sources. We custom build torque motors . . . will work with you to produce the *one* motor that powers your product for peak performance.

Or we may already have your torque motor in our line. It includes, among many others, a weather-proof and explosion-proof valve operator torque motor with brakes, 25 lb. ft., 15 min. duty . . . an explosion-proof torque motor with brake . . . a special flange mounting reversing duty hoist torque motor, single phase and 3-phase.

Take your pick, or state your special needs. We have many standard and special frame sizes; all types of mountings; class A, B, F, and H insulation. Ratings from 2 oz. ft. to 200 lb. ft.

Write for our FREE "New Torque Bulletin." Address: *Peerless Electric Division, H. K. Porter Co., Inc., W. Market St., Warren, Ohio.*

PEERLESS ELECTRIC DIVISION PORTER **H. K. PORTER COMPANY, INC.**

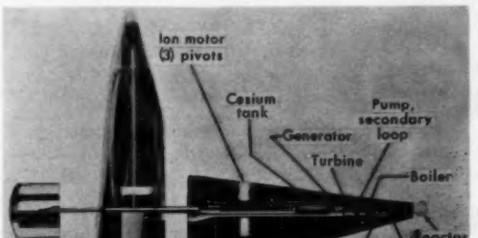
PORTER SERVES INDUSTRY with steel, rubber and friction products, asbestos textiles, high voltage electrical equipment, electrical wire and cable, wiring systems, motors, fans, blowers, specialty alloys, paints, refractories, tools, forgings and pipe fittings, roll formings and stampings, wire rope and strand.

Circle 184 on Reader-Service Card for more information

• **SPUR 300-KW SYSTEM** uses an alkali metal coolant loop and a two-phase Rankine-cycle power conversion loop, also using an alkali metal working fluid. In the working loop, this alkali metal is expanded through an axial turbine to drive a 300-kw generator at 24,000 rpm to produce three-phase, 110v, 320-cps electricity. From the turbine, vapor is condensed in the tube-fin radiator and excess heat is radiated into space. The condensed liquid metal then is pumped back to the boiler.

Turbine-generator package is about 3 ft long 1 ft in dia and weighs 350 lb. Unit is designed for high reliability over a 1 to 3 year operational life. Gas for the ion engines comes from a 2500-lb tank of cesium, providing about 2 lb of thrust at 6000 ips specific impulse.

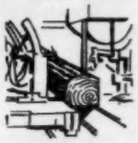
The self-propelled space power unit concept for project SPUR has been proposed to the Air Force by the Garrett Corp. Research Mfg. Div., Phoenix, Ariz.



MEETINGS

New York, N. Y. **Nov. 1-3**	MEETING, Society for Experimental Stress Analysis, Hotel New Yorker.
Chicago, Ill. **Nov. 6-8**	ATOMFAIR '61, Atomic Industrial Forum, Conrad Hilton Hotel.
Los Angeles, Calif. **Nov. 6-8**	SPECIAL TECHNICAL CONFERENCE ON NONLINEAR MAGNETICS, Institute of Radio Engineers, American Institute of Electrical Engineers, Statler Hilton Hotel.
Houston, Tex. **Nov. 9-13**	NATIONAL FUELS AND LUBRICANTS MEETING, Society of Automotive Engineers, Shamrock Hotel.
Phoenix, Ariz. **Nov. 13-16**	SEVENTH ANNUAL CONFERENCE ON MAGNETISM AND MAGNETIC MATERIALS, American Institute of Electrical Engineers and the American Institute of Physics, Hotel Westward Ho.

TORQ SPEED DETECTION CONTROL
...may solve *YOUR* problem
✓SIMPLY
✓POSITIVELY
✓ECONOMICALLY



• A single TORQ SYNPRO-TEX governor cycles an automatic washer during spin-dry to less than 1G to more than 1G to balance the load, get clothes drier and make the wash "fluffy".
• A TORQ MULTITECTOR practically runs a diesel engine. It cuts out cranking motors, engages and disengages cooling circuit, provides fuel requirements at different speeds, then signals full speed.
• TORQ governors relate fuel supply to air supply in power gas burners. A single governor will purge the combustion chamber, then turn on the gas, and during operation if blower falls below required speed for any reason, the governor shuts off the gas.
• In event of overload on a saw mill, due to dull blades, a TORQ governor causes the cutting blade to be withdrawn before damage can occur.
• On electronic equipment blowers, a TORQ governor will cut the equipment out of the circuit in event of blower failure, to protect expensive electronic components against overheating.
• Conveyors are automatically shut off if they fall below predetermined safe speed.
• TORQ governors make an ideal plugging switch to cut out the motor at low speeds close to zero before motor reverses.
• On truck refrigerators, TORQ governors maintain proper voltage and frequency output from the alternator by shifting it through a solenoid actuated transmission at pre-calculated truck engine speeds.

If your device employs a rotating shaft, a TORQ governor can sequence it, control it, provide signals, or monitor it for safety at one or many speeds from zero to more than 15,000 rpm.

Write today for Bulletin No. 250.

Patents & Patents Pending

TORQ ENGINEERED PRODUCTS, INC.
30 West Monroe Street Bedford, Ohio
Phone: BEdford 2-4100

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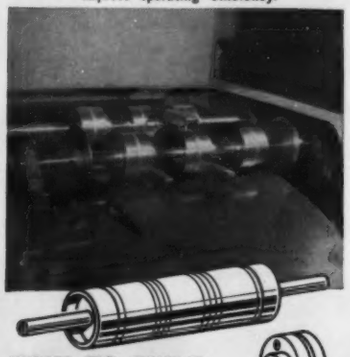
ERIEZ Magnetic Minute

60 seconds that will help you improve operating efficiency.



HOW TO BUILD A PLUS INTO PLANT AUTOMATION SYSTEMS

You can substantially boost the sales appeal of your conveying equipment by incorporating Eriez Magnamation® (permanent magnetic automation) components.

For example—Eriez Magna-Rolls can be used with or without belts to positively hold, control, elevate and carry ferrous materials. They can serve as magnetic feeders to control and feed sheets, blanks and formed parts to any desired operation.

Magna-Rolls are ideal for use with another Eriez Magnamation product — Magna-Rails — to create fully automatic conveying systems.

The rolls are furnished in diameters from 2½" to 30". Various magnetic strengths and field depths can be furnished to meet specific requirements. The range of standard and modified units is wide enough to solve virtually any problem in magnetic conveying and handling.

Eriez broad experience with OEMs, designers, and users is at your service to assist you in the proper application of magnetic components to conveying equipment. Write to:

ERIEZ MANUFACTURING CO.
200XA Magnet Drive, Erie, Pa.

MAGNA-THOUGHT

Most of the very first installations of Eriez equipment are performing as effectively today as they did when they were new, many years ago.

A. F. ISRAELSON
Chief Engineer

ERIEZ

A GROWTH COMPANY . . .
10 NEW PRODUCTS IN THE LAST 5 YEARS

Circle 186 on Reader-Service Card

PLANS AND CROSS-SECTIONS

Personality Plus

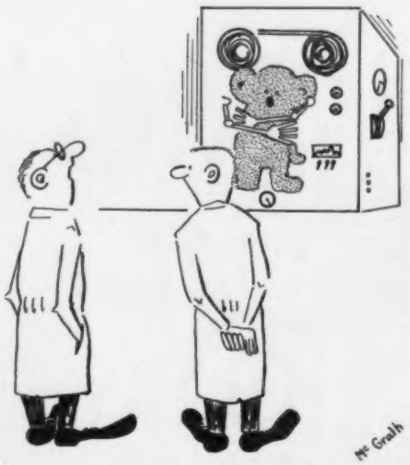
Aldous, an electronic "personality," has been introduced to the American Psychological Association by Dr. John C. Loehlin of the University of Nebraska.

Aldous, named by Dr. Loehlin for Aldous Huxley, the writer, was created as a model of human personality. Actually, Aldous is an electronic computer. Aldous, the developers say, can profit from experience, or learn. He can forget, love, fear and be angry.

In a new situation, Aldous can recognize what he confronts and respond with an appropriate emotion. This can be a positive emotion, such as love, desire or attraction, or it can be one of two negative emotions, anger or fear.

Aldous' emotional reaction depends on both his current mood (that is, a persistence of his emotions from the immediately preceding situation) and his memories of what happened in related situations in the past.

On the basis of his emotional reaction, Aldous acts. He may approach affectionately, attack or withdraw—in each case by printing a number symbolizing that behavior.



"Maybe it's showing insecurity"

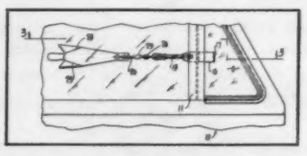
Dr. Loehlin has investigated, he reported, bringing Aldous up in "benign" and "hostile" worlds and what happens when Aldous is shifted from one to the other.

Worst fault of Aldous, Dr. Loehlin said, is his lack of initiative. Sounds like a very human trait.

Keep Your Eyes on the Road

A motor vehicle attachment that supposedly prevents hypnosis caused by steady uninterrupted high-speed travel on modern highways has been patented by E. W. Placek of Cleveland, Ohio.

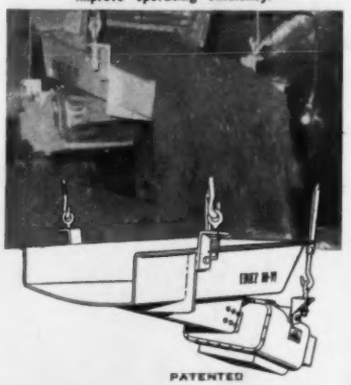
A wedge-shaped plate with fins is dangled from a wire attached to the side window near the driver. The plate produces irregular noises and movement while flapping in the wind, causing the eyes to constantly refocus on the road.



He said if I didn't like his idea I could quit. So I think it'll work.

ERIEZ Magnetic Minute

60 seconds that will help you improve operating efficiency.



PATENTED

HOW TO BUILD A PLUS INTO HEAVY-DUTY MATERIALS HANDLING EQUIPMENT

If the problem is feeding large tonnages of bulk materials with accurate control, consider including Eriez patented heavy-duty vibratory feeders in your new designs for materials handling equipment.

No rectifier is needed with Eriez AC powered feeders. Totally enclosed electro-permanent magnetic drive is ideal for hazardous, dusty, wet, and corrosive installations. New fibre glass springs assure superior performance and control . . . longer life because spring breakage is practically eliminated. Heavier, more rugged construction withstands severe operating conditions. Simple, compact controls require less wiring and installation time.

Illustration shows one of a number of Eriez units available for heavy feeding applications where big capacity and accuracy are essential. Eriez Hi-Vi® vibratory feeders include models with feeding capacities ranging from ounces to many tons per hour.

Write for descriptive bulletin to:

ERIEZ MANUFACTURING CO.
200XB Magnet Drive, Erie, Pa.

MAGNA-THOUGHT

Companies using Eriez components know we will remain faithful suppliers — not potential competitors.

R. F. MERWIN
President

ERIEZ

A GROWTH COMPANY . . .
10 NEW PRODUCTS IN THE LAST 5 YEARS

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DESIGNING *new equipment?*

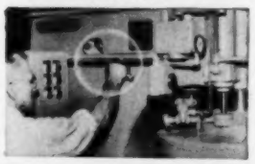
IMPROVING *old equipment?*

SPECIFY

LOWELL
REVERSIBLE RATCHET
WRENCHES

for component parts ▶

for functional accessories ▼



- **modification of a standard wrench...**
- **a special or unusual wrench...**
- **an entirely new design for your job...**

Lowell design/engineering service is anxious to help with all types of problems involving turning adjustments on new or old equipment.

Modification of a standard ratchet wrench may provide a simple, inexpensive solution.

Or one of the many specials we have developed for unusual applications might well be the answer. It could be a bent, hinged or detachable handle; a long or odd-shaped socket; remote reversing control; special materials or finishes.

And if the problem requires an entirely new wrench or related ratchet device, we welcome the chance to help. Save yourself time . . . and rely on our wide experience with designers for the most economical solution.

Send us your special problem now, or write for further information.

LOWELL
WRENCH CO.
91 Temple Street
Worcester 4, Mass.

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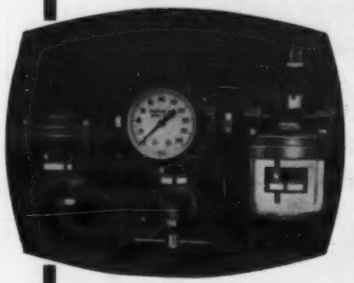

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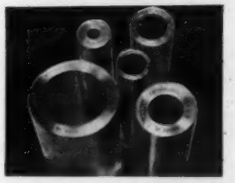

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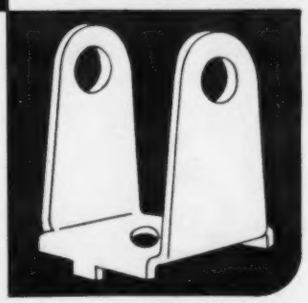

Originally this grey iron casting required expensive milling and drilling operations. In 350 lots the piece price was $1.18 plus pattern, milling fixture and drill jig charges.

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Manufacturing Company
MINNEAPOLIS 7U, MINNESOTA

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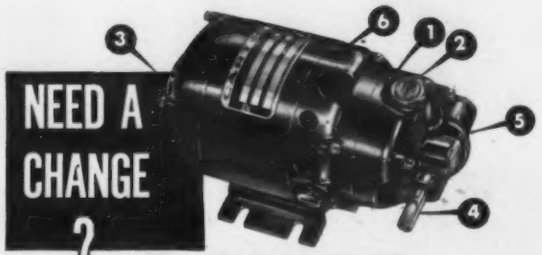

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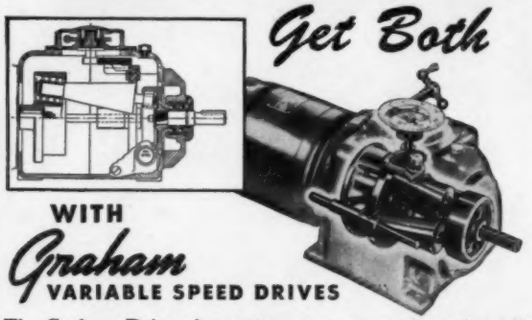

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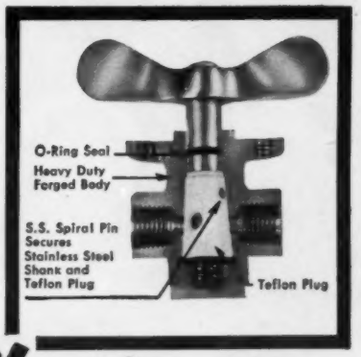

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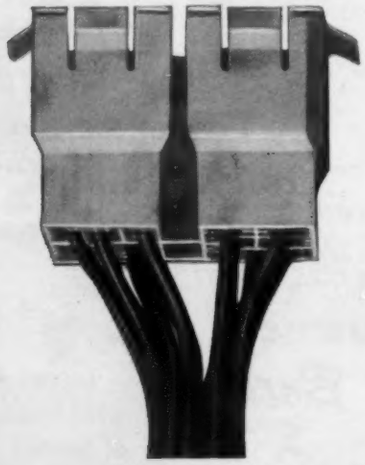

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- self-locking friction contacts create positive wiping action
- low millivolt drop
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- wire ranges #22-#18, #20-#15 and #18-#16 AWG
- nylon housing has "snap-in" wings for through panel use
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- amperage rating 20-25
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- mounts flush—only .125" projects from panel front

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- 1, 2, 6 and 8 circuits
- contacts are self-locking in housing
- fully tested for millivolt drop
- nylon or cycolac housings polarized to prevent circuit errors
- wire insulation support for vibration resistance
- full wire size #18-#14 AWG

* Trademark

This line of AMPin-cert Connectors gives you minimum insertion and withdrawal forces, maximum amperage ratings, resistance to vibration, corrosion and environmental factors . . . everything to assure lower assembly costs, rugged performance and simplified maintenance. Check these features and see how they fit your design plans. Any additional information you may need will be sent on request.

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GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

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Published bi-weekly by Rogers Publishing Co., Inc., a Subsidiary of Cahners Publishing Co., Inc. **Norman L. Cahners**, Chairman of the Board; **E. S. Safford**, President; **Saul Goldweitz, G. F. Taylor**, Vice Presidents. Editorial, Advertising and Subscription Offices: 3375 S. Bannock, Englewood, Colo. Telephone: SUnset 9-0571. Printed at 85 W. Harrison St., Chicago 5, Ill. Accepted as Controlled Circulation Publication at Chicago, Illinois. Send form 3579 to subscription offices.

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for 4 pole = 50×2×60/4 = 1500
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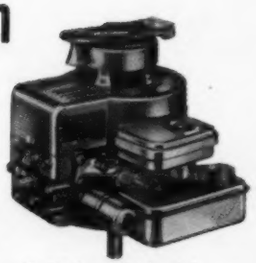

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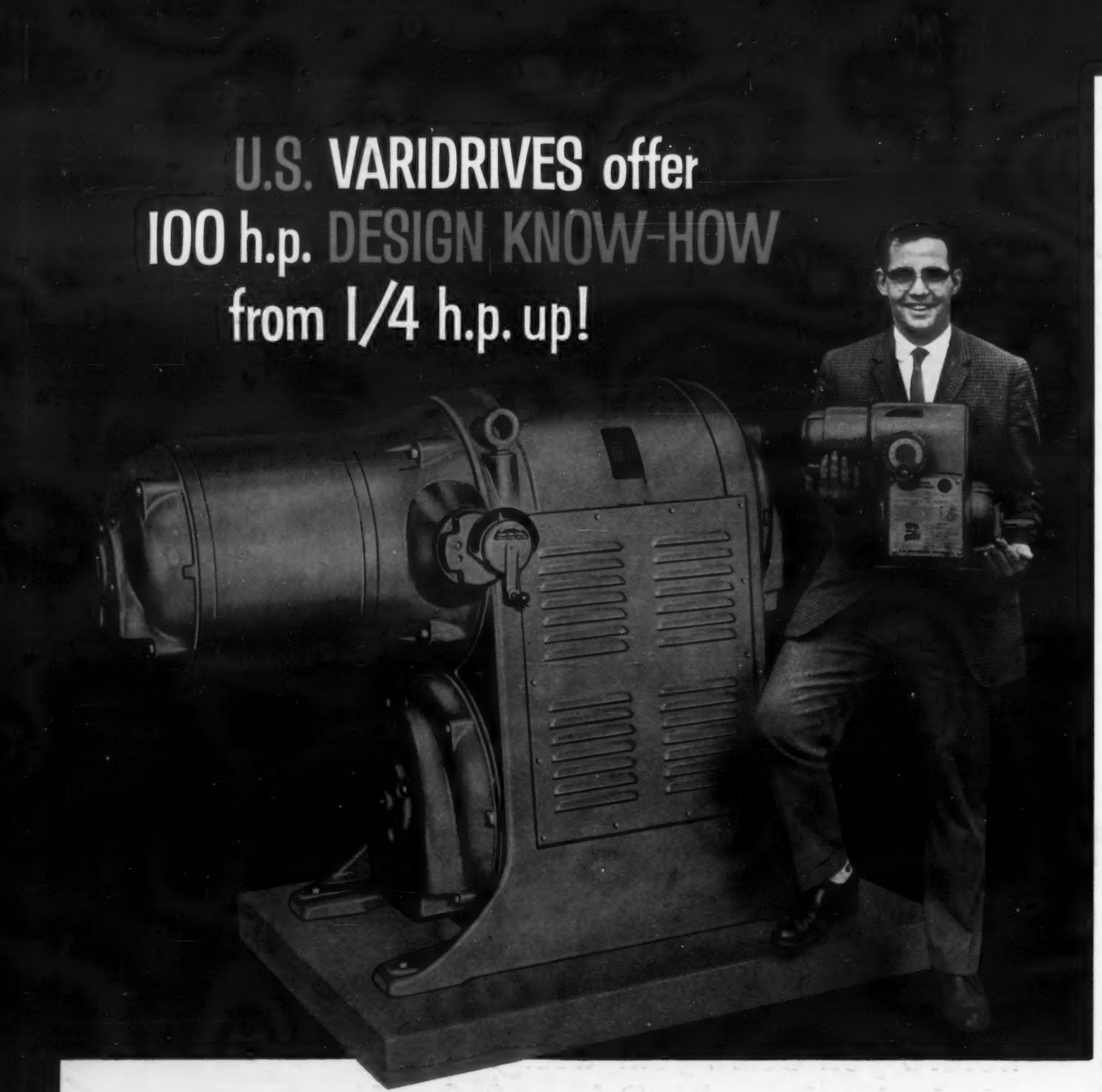

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